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MUNICIPAL, INDUSTRIAL AND DOMESTIC WATER SUPPLIES, POLLUTION ABATEMENT, PUBLIC HEALTH. SAVANNAH BASIN

Public Health Service
Atlanta, Georgia

May 1962

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SAVANNAH
BASIN

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TECHNICAL MEMORANDA FOR WATER SUPPLIES POLLUTION ABATEMENT AND PUBLIC HEALTH

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PREPARED FOR
UNITED STATES STUDY COMMISSION, SOUTHEAST RIVER BASINS
BY
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, REGION IV
WATER SUPPLY & POLLUTION CONTROL PROGRAM
ATLANTA, GEORGIA
MAY 1962

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UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region IV
Water Supply and Pollution Control Program

Technical Memoranda

for

Municipal, Industrial and Domestic Water Supplies
Pollution Abatement
Public Health

SAVANNAH BASIN

Prepared for

United States Study Commission,
Southeast River Basins
Atlanta, Georgia
May 1962

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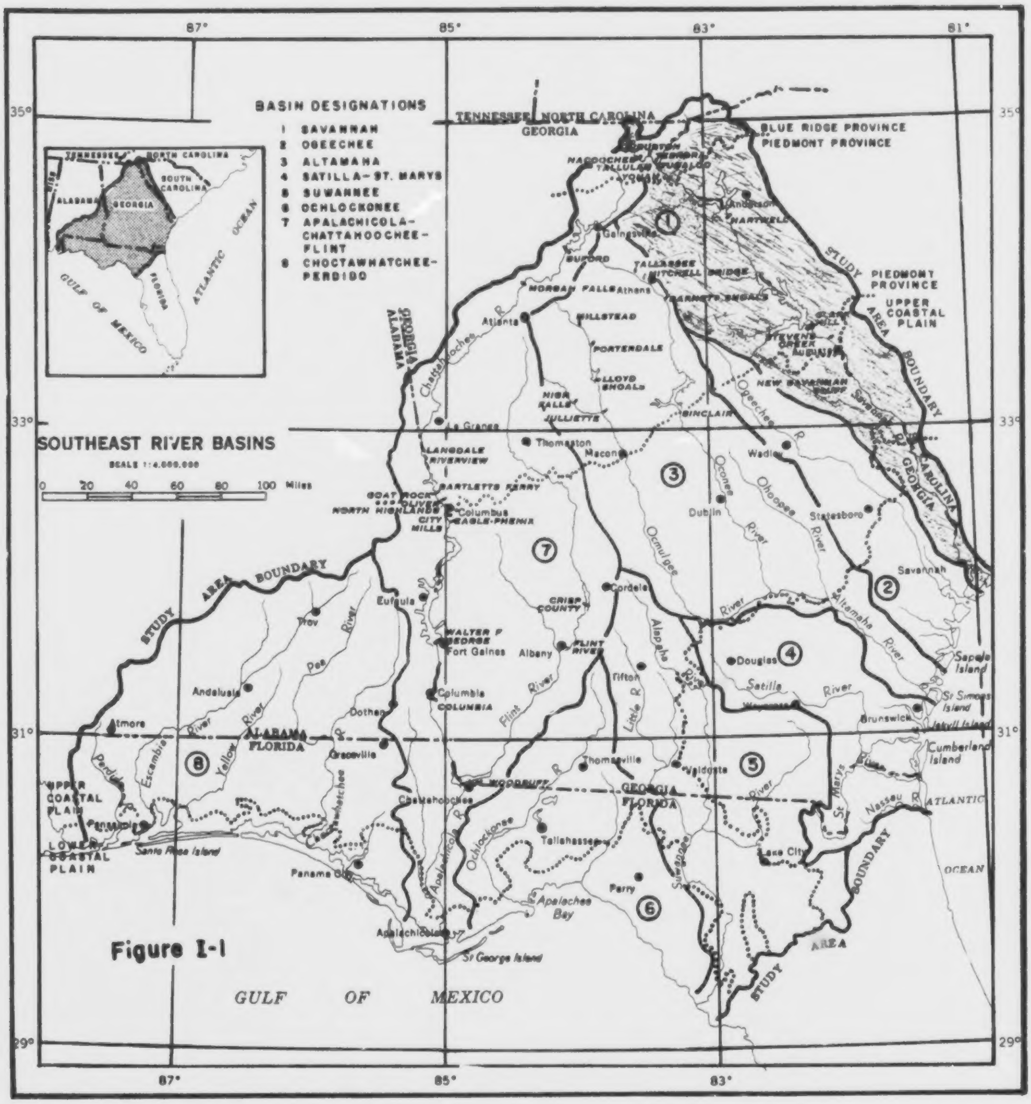
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2 OGEECHEE
3 ALTAMAHA
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5 SUWANNEE
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7 APALACHICOLA-CHATTAHOOCHEE-FLINT
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SOUTHEAST RIVER BASINS
SCALE 1:4,000,000
0 20 40 60 80 100 Miles
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
ALABAMA
GEORGIA
FLORIDA
GULF OF MEXICO
ATLANTIC OCEAN
87°
85°
83°
81°
35°
33°
31°
29°
BLUE RIDGE PROVINCE
PIEDMONT PROVINCE
UPPER COASTAL PLAIN
LOWER COASTAL PLAIN
STUDY AREA BOUNDARY
Anderson
HARTWELL
Gainesville
BUFORD
MORGAN FALLS
Athens
Atlanta
TALLASSEE
MITCHELL BRIDGE
MILLSTEAD
PORTERDALE
LLOYD SHOALS
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Augusta
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Columbia
COLUMBIA
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WOODRUFF
Thomasville
Valdosta
Waycross
Brunswick
Tallahassee
Pensacola
Santa Rosa Island
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Suwannee River
St Marys R.
Nassau R.
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Apalachicola R.
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Pea River
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PREFACE

SCOPE

The U. S. Study Commission, Southeast River Basins, on December 30, 1959 and March 11, 1960, requested the assistance of the Public Health Service in:

(1) Formulating a domestic, municipal and industrial water supply plan, including pertinent economic studies,

(2) Formulating a water quality management plan including water pollution abatement and pertinent economic studies, and

(3) Formulating a plan for the protection of public health related to plans for the conservation, utilization, and development of land and water resources of the study area.

The Study Commission proposed that the Public Health Service compile the required basic data and prepare "single-purpose technical memoranda" on each of the above subjects and that these technical memoranda set forth the requirements for development to serve the above functions at present, in 1975, and 2000 in each of the eight river basins of the study area.

These memoranda on the Savannah Basin have been prepared in fulfillment of the Commission's requests. They have been divided into three separate memoranda: MUNICIPAL, INDUSTRIAL, AND DOMESTIC WATER SUPPLIES; POLLUTION ABATEMENT; and PUBLIC HEALTH. In addition, a separate report has been prepared by the Public Health Service for the U. S. Study Commission: Water Quality Basic Data - Southeast River Basins, dated 1961. This report covers the Savannah Basin as well as the seven other Basins within the U. S. Study Commission study area.

The purpose of these memoranda is to provide data and information to the U. S. Study Commission - SERB on the present and projected status of water supply, pollution abatement, and public health facilities and programs for use in the preparation of a comprehensive plan for the conservation, utilization, and development of the land and water resources of the Savannah Basin.

AUTHORITY

The Study Commission's requests are in partial fulfillment of its obligation under Public Law 85-850 which states in part: "In carrying out the purpose of this Act it shall be the policy of Congress to utilize the services, studies, surveys, and continuing investigational programs of the departments, bureaus, and agencies of the United States". The Act also states that the Commission may "secure directly from any executive department, bureau, agency, commission, office, independent establishment, or instrumentality, information, suggestions, estimates, and statistics for the purpose of this Act, and each such department, bureau, agency, board, commission, office establishment, or instrumentality is authorized to furnish such information, suggestions, estimates and statistics directly to the Commission, upon request by the Chairman or Vice Chairman".

The authority for the Public Health Service to undertake this study and the preparation and submission of these technical memoranda stems from the above and from the Public Health Service Act of 1944 (Public Law 410, 78th Congress) and its amendments; the Federal Water Pollution Control Act (Public Law 660, 84th Congress), and its amendments; Federal legislation on air pollution (Public Law 159, 84th Congress), with amendments; related miscellaneous provisions of other statutes; and the Public Health Service Regulations.

Public Law 85-850, under which the U. S. Study Commission operates, provides for investigations and studies and the preparation of a comprehensive and coordinated plan for the conservation, utilization, and development of land and water resources in the study area. In this plan formulation, the law specified, among other things, the inclusion of plans for:

(1) domestic and municipal supplies;

(2) possibilities of industrial development and utilization;

(3) pollution abatement and the protection of public health; and

(4) other beneficial and useful purposes.

ECONOMIC BASIS FOR PLANNING

Projections for 1975 and 2000 in this report were made using estimates of economic development furnished to the Public Health Service by the U. S. Study Commission, Southeast River Basins. The pattern of the future economy stems mainly from projections of population, employment, and income furnished by the Commission. The basic aggregate projections for these three components are considered by the Commission to be relatively firm. The breakdown of the basic projections into their different components and the derivation of data for river basins is based, in some cases, on limited information. The Commission emphasizes that these are preliminary estimates and that the pattern of the projected economy should not be taken as a rigid goal but should be considered flexible and subject to modification and refinement as the results of future studies become available.

RESPONSIBILITIES

The basic responsibility for the administration of Federal programs in municipal water supply, pollution control, and public health is vested in the Public Health Service. State programs and responsibilities are administered by the State health departments and water pollution control agencies. In the administration of these Federal and State programs, cooperation and assistance of other agencies with interests in these fields are obtained. The responsibilities and interests of all Federal, State, and local agencies in municipal water supply pollution control and public health programs in the Savannah Basin are enumerated below.

PUBLIC HEALTH SERVICE, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

The Public Health Service serves in a consulting capacity to other Federal agencies and to the State and local health departments on matters relating to water supply, water pollution control, vector control, and other matte related to public health; makes investigations and studies; does scientific research in the above fields; collects vital statistics; and operates certain medical care and quarantine programs. In protecting the public health, the Service is responsible for developing and recommending procedures for the prevention and control of mosquitoes and other vectors associated with Federal water development projects.

As part of its responsibilities under the Federal Water Pollution Control Act (Public Law 660, 84th Congress) as amended, the Service is required to prepare or develop in cooperation with other Federal agencies, State and interstate water pollution control agencies, municipalities and industries, comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof and improving the sanitary conditions of surface and underground waters. In the development of such comprehensive programs, due regard is given to the improvements which are necessary to conserve such waters for public water supplies; propagation of fish and aquatic life and wildlife; recreational purposes; and agricultural, industrial, and other legitimate uses. The Service is further authorized to advise any Federal constuction agency concerning the inclusion of storage in any proposed reservoir for regulations of stream flow for the purpose of water quality control.

The Public Health Service is authorized to make joint investigations, with any such agencies, of the condition of any waters in any State or States, and of the discharge of any sewage, industrial wastes, or substance which may adversely affect such waters.

Section 8 (a) of Public Law 660 states that "The pollution of interstate or navigable waters in or adjacent to any State or States (whether the matter causing or contributing to such pollution is discharged directly into such waters or reaches such waters after discharge into a tributary of such waters), which endangers the health or welfare of any persons shall be subject to abatement as provided in this Act."

The Public Health Service works closely with State agencies and makes investigations and studies relating to health and pollution control aspects of development programs pertaining to municipal, industrial, and domestic water supplies. The Service also has the responsibility of collecting and disseminating basic data on radiological, chemical, physical, and biological water quality and other informaton insofar as such data and information relate to water pollution and the prevention and control thereof.

CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY

The Corps of Engineers operates the Federal program for the improvement and maintenance of rivers and other waterways in the interest of navigation and flood control. Water conservation and other water use functions beneficial to the public are considered in carrying out investigations and construction of water projects. Health matters relating to these projects include vector control, sanitation of work camps, recreation, water supplies, and water pollution abatement.

SOIL CONSERVATION SERVICE, DEPARTMENT OF AGRICULTURE

The Soil Conservation Service, under Public Law 566, 83rd Congress, as amended, prepares watershed work plans for small watersheds to assure water-flow retardation and soil erosion prevention. In the development of these work plans, consideration is given to water use functions beneficial to the people of the area, including irrigation, stock watering, and fish and wildlife propagation and municipal and industrial water supply. Control of insects around the watershed and use of water for domestic purposes are also given consideration.

FOREST SERVICE, DEPARTMENT OF AGRICULTURE

The Forest Service is responsible for the development and management of National Forests to preserve and increase the multiple benefits from these natural resources. Good forest management retards rapid runoff and prevents soil erosion, thus reducing pollution from natural sources. Sanitation of public facilities in National Forests is under the supervision of the Forest Service and privately operated facilities are regulated by use permits issued by the Service. It is to be noted, however, that Section 480, Title 16, U. S. Code states that jurisdiction over persons within National Forests should not be affected by the reason of these forests' existence. Thus, health and sanitation in National Forests is of concern to State and local health authorities.

GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

The Geological Survey is primarily a fact finding and research agency. It collects, analyzes, and interprets basic data on water, mineral, and land resources, and prepares topographic and geological maps and reports as a prerequisite to planning, constructing, and operating projects for the development and utilization of these natural resources.

NATIONAL PARK SERVICE, DEPARTMENT OF THE INTERIOR

The National Park Service administers programs for the National Parks, monuments, historic sites, and similar areas. It has the responsibility for maintaining sanitary and healthful conditions in these areas. The Service cooperates with other agencies in investigating the recreational possibilities at proposed reservoir projects and in planning for their protection, development, and utilization.

ATOMIC ENERGY COMMISSION

The Atomic Energy Act of 1954 authorizes the Atomic Energy Commission to regulate the use of certain radioactive materials and certain facilities, which produce or use these materials, to protect against hazards to life or property. A National Committee on Radiation Protection, comprised of members of several Federal agencies including the Public Health Service and professional organizations, prepares recommendations on protection from radioactive substances.

GEORGIA DEPARTMENT OF PUBLIC HEALTH

The State has retained all responsibilities and duties for the health of the public not otherwise granted to the Federal government in the Federal Constitution or by Acts of Congress. The State operates under the police power, inherent in the sovereign State to enact and enforce laws to protect and promote the health, safety, morals, order, peace, comfort, and general welfare of the people. Among the powers of the State Board of Health are the following

1. Adopt rules, regulations, and orders.

2. Enforce State laws, regulations, and orders.

3. Isolate and quarantine, make sanitary investigations and inspections, and collect vital statistics.

4. Review plans and specifications for any new municipal water systems to be installed, or changes to be made in any existing system by any city, corporation, partnership, or individual.

5. Inspect the source of municipal water supply, and to determine if the water is impure and dangerous to individuals or to the public generally.

6. Act in a consultative capacity to local agencies.

7. Approve and regulate the impounding of waters as they affect insect and vector control.

The Georgia Water Quality Act (Laws of Georgia, 1957, Act No. 491) provides for the control of water quality within the State and the regulation of public water supply treatment facilities. It prohibits the discharge of sewage, industrial wastes, or other wastes into the waters of the State which would adversely affect the health of the people or render such waters unsuitable for their then current uses, and provides for the treatment of such wastes. It provides for the issuance of certificates to persons discharging or permitting to be discharged into the waters of the State any sewage, industrial wastes, or other wastes.

The Act declares it to be the policy of the State of Georgia that the water resources of the State shall be utilized prudently to the maximum benefit of the people without so impairing the quality of the water resources as to jeopardize public water supplies and public health, and without interfering unreasonably with beneficial use of the water resources for recreation, fish and wildlife development, agriculture, and the industrial development of the State's natural resources and its manpower. The State water pollution control agency (State Board of Health) is charged with the responsibility, and has the authority to require the use of reasonable methods to prevent and control the pollution of the waters of the State.

The State Board of Health under the Water Quality Act, has the responsibility and power to, as it deems necessary, establish such standards of quality for any waters in relation to the reasonable and proper use thereof, and such general policies and standards relating to any existing or future pollution of such waters. The State Board of Health has the power to issue orders directing any particular person or persons to secure within the time specified therein, such operating results as are reasonable and practicable of attainment toward the control, abatement, and prevention of pollution of the waters of the State and the preservation of the necessary quality for the reasonable use thereof.

The State Board of Health has the power to establish such policies, requirements, and/or standards governing the source, distribution, purification, treatment and storage of water for public or community water supply systems as it deems necessary for the reasonable and proper use thereof in conformity with the intent of the Water Quality Act. The Act states that it shall be unlawful for any person to erect, construct, enlarge, extend, open, reopen, or operate any public or community water supply system, including storage, distribution, purification treatment facilities or works, without having first secured from the Board approval of the source of water supply; the means and methods of treating, purifying and storing water; plans and specifications for the construction of facilities or works; and the operation thereof.

LOCAL HEALTH DEPARTMENTS (GEORGIA)

Georgia laws provide for the formation of county boards of health. These are created for the purpose of carrying out State rules, regulations, and orders as well as adopting other regulatory measures needed for protecting the public health within the local jurisdiction. Local Boards of Health in Georgia have the power to:

1. Adopt rules, regulations, and orders.
2. Enforce State laws, regulations, and orders.
3. Enforce local regulations and ordinances.
4. Make sanitary inspections and investigations, isolate, quarantine, and abate nuisances.

GEORGIA OIL AND GAS COMMISSION

The Georgia Oil and Gas Commission is authorized to make rules, regulations, and orders for the prevention of the pollution of fresh water supplies by oil, gas or salt water (1955 Cum. Supp., Title 43, Section 713).

GEORGIA GAME AND FISH COMMISSION

In the protection of fish and other aquatic life, the Georgia Game and Fish Commission is vitally interested in habitat waters. This agency cooperates with other State and Federal agencies in investigations and studies of water quality as related to fish and other aquatic life. This Agency enforces legislation against the use of explosives, poisonous substances, etc. for the purpose of catching, killing, taking or harming fish (1955 Cum. Supp., Title 45, Section 703).

GEORGIA WATER QUALITY COUNCIL

The Georgia Water Quality Council makes recommendations to the State Board of Health with regard to regulations, procedures, standards, waste disposal certificates, and policies governing public and community water supplies and waste disposal into waters of the State for controlling pollution and quality of such waters.

GEORGIA DEPARTMENT OF MINES, MINING, AND GEOLOGY

The Division of Conservation in this Department collects and compiles water resources data and cooperates with the U. S. Geological Survey, U. S. Soil Conservation Service, and State Soil Conservation Committee on surface and ground water surveys and chemical quality of waters.

GEORGIA RESOURCES COMMISSION

The Commission is responsible for inventorying the State's water resources and gathering such data as are necessary for determing what further legislation is needed with regard to quantitative control of the State's water resources. A State water engineer, appointed by the Commission is authorized to employ a water resources fact finding and research staff to be known as the Georgia State Water Survey.

SOUTH CAROLINA STATE BOARD OF HEALTH

Under South Carolina statutes, the State Board of Health is empowered to make, adopt, promulgate, and enforce reasonable rules and regulations concerning the various aspects of public health maintenance. Within these rules and regulations are provisions for disposition of sewage and refuse and for control of public water supplies.

The Board reviews and approves plans and specifications for installing and/or making additions, changes or alternations in a water supply, water purification plant for a municipality, district, corporation, company, institution, person or persons. Sanitary surveys and laboratory examinations are peformed in order to insure the safety and quality of public water supplies. New water purification plant or distribution system inspections are also a function of the State Board of Health.

Among the other duties of the Board are enforcement of trailer camp, mosquito production, and hotel regulations. Details regarding the various rules and regulations are found in the 1942 Code of Laws of South Carolina. Pollution violations are reported to the Water Pollution Control Authority.

SOUTH CAROLINA WATER POLLUTION CONTROL AUTHORITY

The South Carolina Water Pollution Control Law in 1950 created an Authority to safeguard the waters of the State from pollution by (a) minimizing any new pollution and (b) abating pollution existing on May 4, 1950. The Water Pollution Control Authority is responsible for stream classification, stream pollution investigations, sewage treatment plant plan review, and enforcement of the Water Pollution Control Law.

Permits are issued by the Authority for discharge of sewage of wastes into State waters for construction of or change in waste disposal systems. Applications for grants under the Federal Water Pollution Control Act are approved by the Authority.

Public hearings are conducted in connection with or prior to action in cases involving: (a) discontinuance of waste discharge orders, (b) an order denying or revoking permits, (c) a determination that a discharge constitutes pollution, or (d) any other proceeding that results in a finding that waste discharges contravene standards established for waters. Any person who willfully violates any final determination or order of the Authority is guilty of a misdemeanor and is subject to fine or imprisionment.

SOUTH CAROLINA WILDLIFE RESOURCES COMMISSION

The Wildlife Resources Commission supervises and directs the Divisions of Game and Commercial Fisheries. Depositing of any deleterious substance in fresh or salt water in quantities sufficient to injure or kill any fish is unlawful (Section 28-671). Poisoning of streams or other waters for the purpose of taking fish in punishable by fine or imprisonment (Sections 28-672, 28-673).

LOCAL HEALTH DEPARTMENTS (SOUTH CAROLINA)

South Carolina is divided into health districts, and in those districts where no board of health exists, a sub-board has been appointed. Local boards are subject to supervisory and advisory control of the State Board and no local board may pass ordinances repugnant to the rules and regulations of the State Board.

WATER PURVEYORS

The general responsibility for the purity of water is shared by health authorities, water purveyors, owners of property, and water users. Those duties of health authorities and other agencies have been presented. The purveyor of water must safeguard it while in the water supply system, with some overlapping responsibilities with the property owner once the water reaches the property line. Regulations controlling the manufacturing, importing or bottling of water in the Basin are administered by the Georgia and South Carolina State Boards of Health.

DESCRIPTION OF THE BASIN

GENERAL

The Savannah Basin is bounded in the northeast by the Congaree Basin and Edisto - Combahee Basin, on the southwest by the Ogeechee Basin and Oconee Sub-basin, on the northwest by the Chattahoochee Sub-basin and on the north by the Tennessee River System (Figure I-1). The Savannah River is formed by the confluence of the Tugaloo and Seneca Rivers in the Georgia - South Carolina - North Carolina Piedmont Province. In general, the Savannah flows in a southeasterly direction and with certain tributaries forms the boundary between Georgia and South Carolina from North Carolina to the Atlantic Ocean.

Over half of the 10,600 square mile Basin area lies within the Piedmont Province (about 6,800 square miles). Approximately 3,400 square miles of the Basin is located in the Coastal Plain region of Georgia and South Carolina, and the remaining 400 square miles, a portion of which is in North Carolina, is in the Blue Ridge Province or mountain section. Elevations in the Piedmont section, which is essentially an upland of fairly strong relief with some deep valleys, varies from 500 feet at the fall line to about 1800 feet. Lack of falls and rapids is a predominate feature of the Coastal Plain region, and swampy areas adjacent to the River are common. River slopes in the Basin vary from 122 feet per mile in the mountains to 0.6 feet per mile below Augusta, Georgia.

Hartwell and Clark Hill Reservoirs are the largest storage developments in the Basin. Hartwell Reservoir is under construction and Clark Hill, completed in 1951, has a usable capacity of 1,730,000 acre-feet. A number of smaller impoundments are located upstream from these two reservoirs. Combined usable capacity of these is 169,000 acre-feet. During periods of flood, these impoundments materially reduce flows downstream. Diurnal and weekly flow fluctuations exist below many of the larger dam sites.

In general, the mineral quality of water in Savannah Basin streams is good. Waters are usually soft and clear, except in the lower sections, and dissolved solids content ranges from 30 to 50 parts per million (ppm). Reservoirs in the Basin affect water quality by leveling out diurnal and seasonal variations in mineral content. Color content increases downstream and reaches a maximum near the mouth.

CLIMATE AND HYDROLOGY

The climate of the upper portion of the Basin is relatively temperate. Average temperatures are higher in the downstream section due to the influence of decreasing altitude. Mean annual temperatures range from 61°F to 65°F. Rainfall is very evenly distributed throughout the year and floods that do occur are seldom serious especially with flood control provided by Hartwell and Clark Hill Reservoirs. Mean annual rainfall varies from 58 inches in the upper Basin to 46 inches in the coastal plain. As the Savannah Basin lies in the path of hurricanes, heavy rainfalls do occur in late summer or fall.

The principal tributaries of the Savannah River are the Tugaloo, Seneca, Keowee, Broad, and Little Rivers, and Horse Creek. The average discharge in the Tugaloo River near Hartwell, Georgia, for 21 years of record (1925-1927, 1940-1959) was 1,923 cubic feet per second (cfs). Maximum discharge for the period of record was 28,600 cfs; minimum daily discharge was 188 cfs. The average discharge in the Seneca River near Anderson, South Carolina, for 31 years of record (1928-1959) was 1,997 cfs. Maximum discharge for the period of record was 81,000 cfs; minimum daily discharge was 170 cfs. Average discharge in the Savannah River at Augusta, Georgia, for 52 years of record (1883-1891, 1896-1906, 1925-1959) was 10,120 cfs. Maximum discharge for the period of record was 350,000 cfs; minimum daily discharge was 1,040 cfs. Average discharge in the Savannah River near Clyo, Georgia, for 26 years of record (1929-1933, 1937-1959) was 11,080 cfs. Maximum discharge for the period of record was 270,000 cfs; minimum daily discharge was 1,950 cfs.

Ground water in the Savannah Basin occurs at depths ranging from a few feet to several thousand feet. In the Blue Ridge and Piedmont Provinces, ground water is located primarily under water-table conditions in crystalline-rock aquifers. The amounts available depend upon such factors as rock type, rainfall intensity, and permeability of stratum. Thickness of the water bearing stratum is from 5 to 80 feet.

Chief aquifers of the Coastal Plain area are the principal artesian and Cretaceous. The principal artesian limestone strata are up to 600 feet thick and are located from near the surface to 500 feet deep. Ground water from the principal aquifer is the major source of water supply in the Savannah, Georgia vicinity.

Cretaceous sand aquifers supply water for much of the central Savannah Basin. These water bearing strata consist of crossbedded sand and gravel, interbedded with clay and sandy clay. Along the Fall Zone, the aquifer is less than 200 feet thick but it thickens to almost 800 feet 30 miles to the south. Water under both artesian and water table conditions occurs in the Cretaceous aquifers, and is found at depths varying from a few feet to several hundred feet.

POPULATION

The major population centers of the Savannah Basin are located at Savannah and Augusta in Georgia; and Aiken and Anderson in South Carolina. In 1960, the official census populations of these municipalities was 149,245; 70,626; 11,243; and 41,316 respectively. Both Savannah and the Augusta - North Augusta area are considered Standard Metropolitan Statistical Areas by the Bureau of the Census.

Total 1960 census population in the Savannah Basin was 731,700. This figure represents an increase of 7.6 percent over the 1950 population. Urban population increased 21.2 percent during the 1950-1960 decade while rural population decreased by 6.1 percent or by some 23,500 persons. The majority of persons in the Basin reside in Georgia and South Carolina; only 6,400 persons are residents of the North Carolina section.

RESOURCES

Agricultural operations are carried on thoughout the Savannah River watershed. The soil is adapted to the growing of fruit, truck and grain crops, cotton and hay, and to the production of poultry, eggs, and livestock. The largest farms are found in downstream areas, since the upstream farming is limited by erosion and hilly terrain.

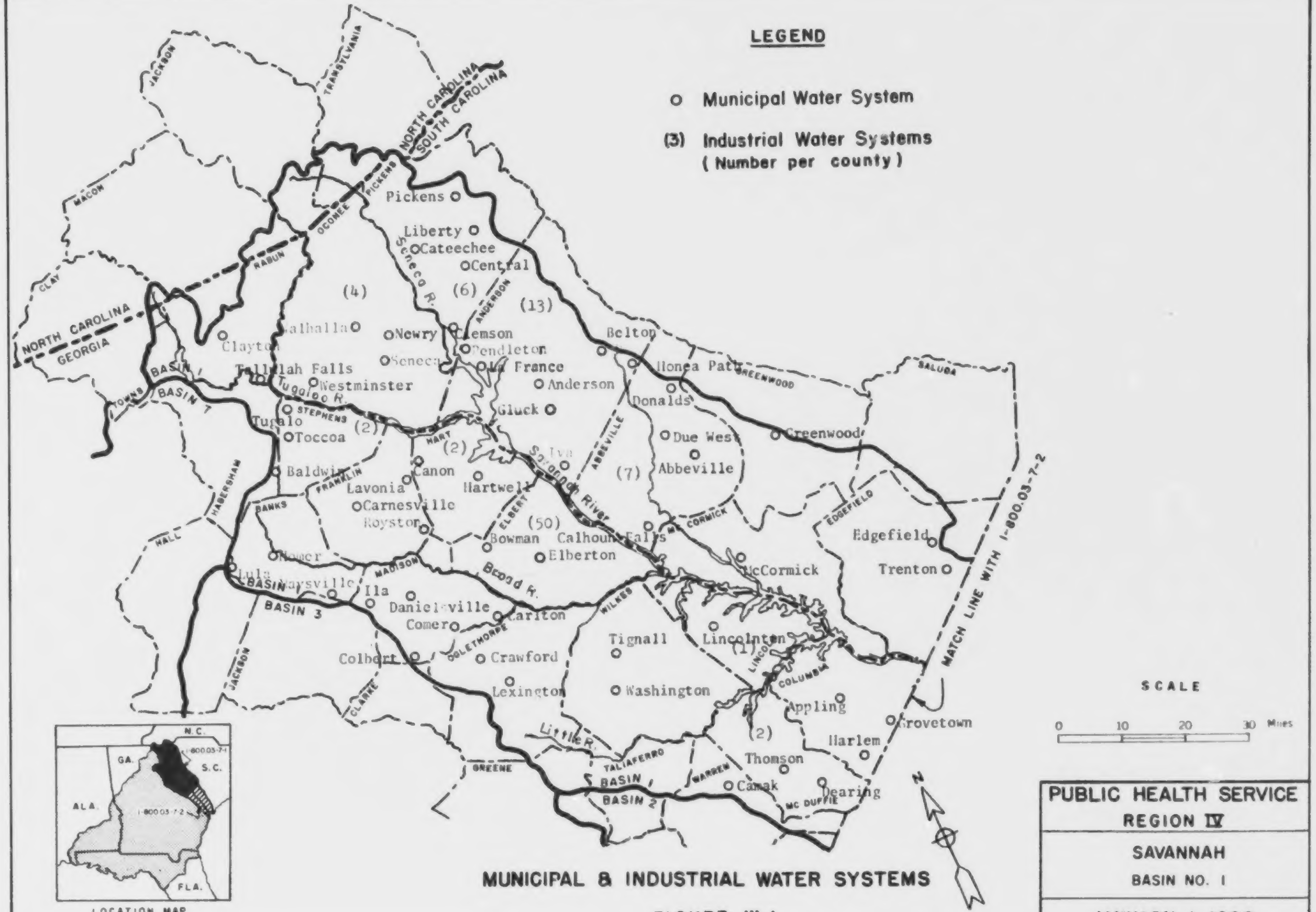
Industrial development in the South Carolina portion of the Basin is mostly textile. Most towns in this part of the area have a textile plant, but production is generally confined to spinning and weaving with few plants engaged in finishing, printing, or dyeing. In the Georgia portion of the Basin are found kaolin and asbestos mines, textile product centers, paper mills, fertilizer plants, large timber stands, and naval stores. Savannah, Georgia is an important ocean shipping port and the River is navigable by barge from Savannah to Augusta.

Hydroelectric power in the Basin has been developed by several dams in the Piedmont and Blue Ridge Provinces. Auxiliary uses of the reservoirs created behind these dams include recreation and wildlife conservation. River fishing is generally confined to the upper half of the Basin, and many mountain streams are stocked with trout.

With increased development of the resource potential of the Savannah Basin, the population is expected to double by the year 2000.

W-1

MUNICIPAL, INDUSTRIAL AND DOMESTIC WATER SUPPLIES


LEGEND
○ Municipal Water System
(3) Industrial Water Systems (Number per county)
SCALE
0 10 20 30 Miles
MATCH LINE WITH 1-800.03-7-2
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
BASIN 1
BASIN 2
BASIN 3
BASIN 7
Savannah River
Seneca R.
Tugaloo R.
Broad R.
Little R.
JACKSON
TRANSYLVANIA
MACON
CLAY
RABUN
OCONEE
PICKENS
ANDERSON
TOWNS
HABERSHAM
STEPHENS
FRANKLIN
HART
BANKS
HALL
MADISON
ELBERT
ABBEVILLE
GREENWOOD
SALUDA
EDGEFIELD
McCORMICK
WILKES
OGLETHORPE
CLARKE
LINCOLN
COLUMBIA
TALIAFERRO
WARREN
McDUFFIE
GREENE
Pickens
Liberty
Cateechee
Central
(4)
(6)
(13)
Walhalla
Newry
Clemson
Seneca
Pendleton
La France
Anderson
Belton
Honea Path
Donalds
Clayton
Tallulah Falls
Westminster
Gluck
Tugalo
Toccoa
(2)
Due West
Abbeville
Greenwood
Baldwin
Canon
Lavonia
Carnesville
Royston
Hartwell
Iva
(7)
Bowman
(50)
Calhoun Falls
Elberton
Edgefield
Trenton
McCormick
Homer
Lula
Maysville
Ila
Danielsville
Comer
Carlton
Tignall
Lincolnton
(1)
Colbert
Crawford
Lexington
Washington
Appling
Grovetown
Harlem
Thomson
Camak
Dearing
N
N.C.
S.C.
GA.
ALA.
FLA.
1-800.03-7-1
1-800.03-7-2
LOCATION MAP

MUNICIPAL & INDUSTRIAL WATER SYSTEMS

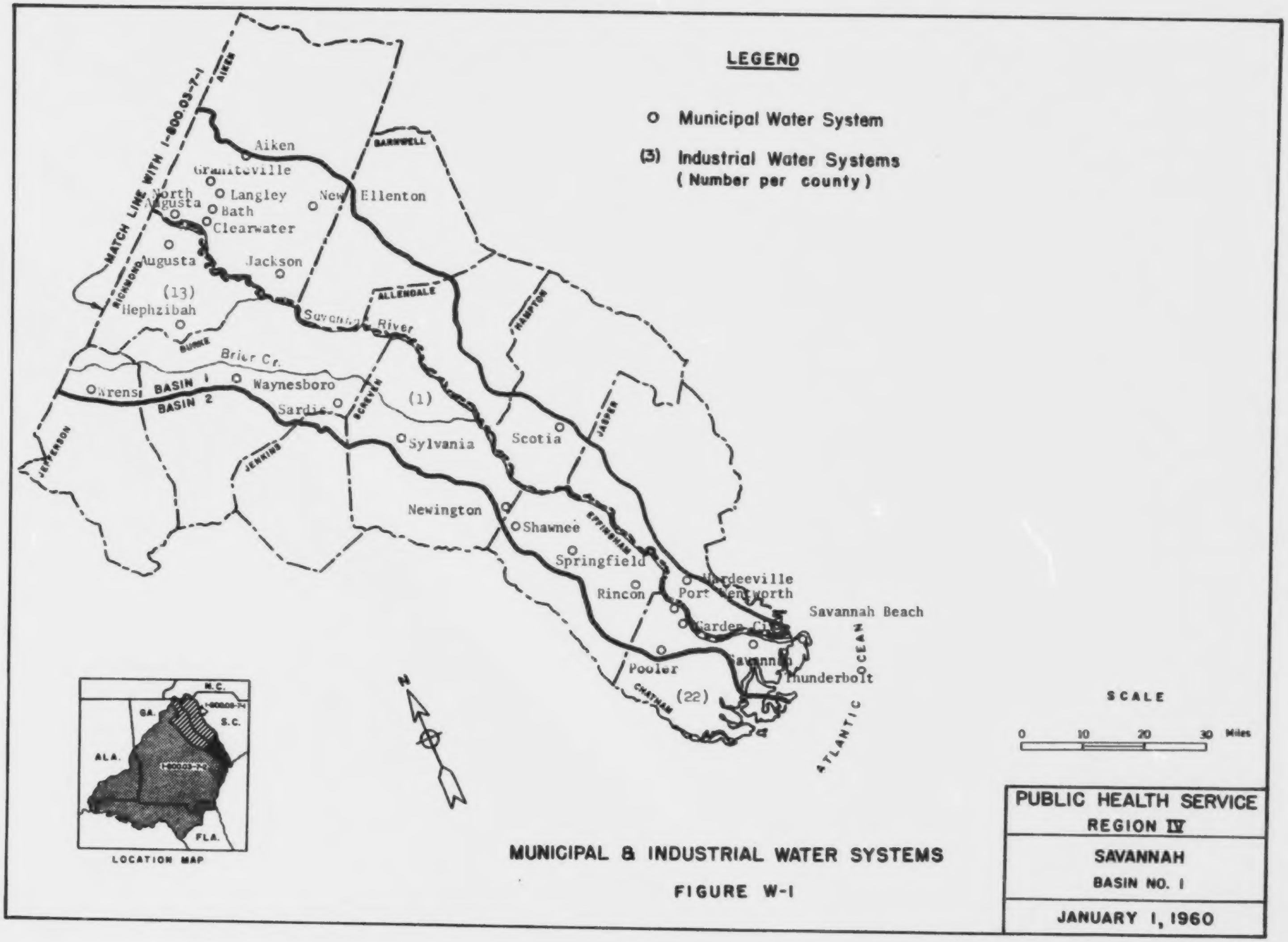
FIGURE W-1

PUBLIC HEALTH SERVICE
REGION IV

SAVANNAH
BASIN NO. 1

JANUARY 1, 1960

W-1-a


LEGEND
○ Municipal Water System
(3) Industrial Water Systems (Number per county)
MATCH LINE WITH I-800.03-7-I
AIKEN
BARNWELL
ALLENDALE
HAMPTON
JASPER
RICHMOND
BURKE
SCREVEN
JENKINS
JEFFERSON
EFFINGHAM
CHATHAM
Aiken
Graniteville
North Augusta
Langley
Bath
Clearwater
New Ellenton
Augusta
Jackson
(13)
Hephzibah
Savannah River
Brier Cr.
Wrens
BASIN 1
BASIN 2
Waynesboro
Sardis
(1)
Sylvania
Scotia
Newington
Shawnee
Springfield
Rincon
Hardeeville
Port Wentworth
Garden City
Savannah Beach
Savannah
Thunderbolt
Pooler
(22)
ATLANTIC OCEAN
N
SCALE
0 10 20 30 Miles
N.C.
GA.
S.C.
ALA.
FLA.
I-800.03-7-I
LOCATION MAP

MUNICIPAL & INDUSTRIAL WATER SYSTEMS

FIGURE W-1

PUBLIC HEALTH SERVICE
REGION IV
SAVANNAH
BASIN NO. 1
JANUARY 1, 1960

W-1-b

INTRODUCTION

SCOPE OF MEMORANDUM

This memorandum contains data and information concerning the present status of municipal, industrial, and domestic water supply systems whose source of water is in the Savannah Basin. Although an attempt was made to collect data on semi-public water supplies, the amount of information available was not sufficient to warrant inclusion in this memorandum. Estimated future water requirements in the Basin for the years 1975 and 2000 are also presented, as are suggested solutions to present and anticipated future water supply inadequacies. In connection with these suggested solutions, an appraisal of the benefits to be derived and the annual costs of obtaining water are included.

This memorandum contains no data concerning water requirements of steam-electric generating stations located in the Basin nor does it include water supply data on the Savannah River Plant of the Atomic Energy Commission.

PROCEDURES AND INVESTIGATIONS

Existing data on water demand and availability were obtained from reports, records, and correspondence of the Georgia Department of Public Health, the South Carolina Board of Health, U. S. Department of Agriculture, Georgia State Chamber of Commerce, the Georgia Department of Commerce, and other Federal and State agencies. Where data were found to be lacking or out-dated, extensive field investigations were conducted. Field investigations were conducted in the Georgia portion of the Basin during January and February, 1961 by the Georgia Department of Public Health. The data obtained were submitted to the Public Health Service for inclusion in this memorandum. The field investigations made by the Georgia Department of Public Health included visits to municipalities, small communities, industries, institutions, semi-public water users, and a limited number of domestic water users.

Data were obtained regarding the municipal water supply systems in the Basin from water plant records, plant operators and officials, and by first hand observations of plant conditions.

Data on industrial water use were obtained from the municipalities furnishing the water, or when an industrially-owned water supply system was involved, from the industry itself. Location of municipal and industrial water supply systems is shown by Figure W-1.

Little information was available concerning the large number of existing domestic water supply systems. Because limited time and funds would not permit a complete inventory of all domestic water systems, a random sample survey of approximately 500 systems throughout the SERB area was made. The data thus obtained were analyzed and certain conclusions were drawn regarding the average number of persons served by each system, the percentages of the various types of wells and equipment, and the extent of improvements needed. These SERB area averages were applied to the Savannah Basin.

BASIC ASSUMPTIONS

Populations of individual municipalities have been projected to 1975 and 2000 using census data where available or estimated populations for communities not listed in census reports. Projections were made by applying the geometric progression method based on the rate of increase over the period 1930-1960 modified by considerations of changing economic conditions. However, the population projections of urban areas (Municipalities of 2500 or more) were adjusted to match projections made by the U. S. Study Commission.

For purposes of this memorandum, future water demands were determined using projected populations and estimated per capita water use. The 1975 needs were determined using a water demand of 100 gallons per capita per day (gpcd) in municipalities of under 1,000 persons and 150 gpcd in municipalities of 1,000 or more. The 2000 projections were based on a water demand of 150 gpcd in municipalities of less than 1,000 persons and 200 gpcd in municipalities of 1,000 or more.

The number of domestic (farm and rural non-farm) water users was estimated for 1960, 1975, and 2000. This number was determined by obtaining the difference between the population served from municipal water systems and the total population of the Basin. Future domestic water demand was estimated by using 70 gpcd in 1975 and 100 gpcd for 2000. A figure of 4.5 persons per system was used to determine the number of domestic water supply systems. All future systems were assumed to be pressurized.

Projections of industrial water system demands (for those industries receiving all or a portion of their supply from industrially-owned systems) were determined by assuming that water demands will increase or decrease in direct proportion to projected industrial growth or decline. In addition, several new industries are expected to locate in the Basin.

January 1, 1960 constant dollars were used for the purpose of estimating annual capital costs, annual operation and maintenance costs, and annual replacement costs of existing and needed water supplies. An interest rate of 4¼ percent was used for determining annual costs for municipal, domestic, and industrial water supply systems.

Water supply system costs have been estimated on the basis of per capita cost data developed by the Public Health Service and adjusted to the January 1, 1960 Engineering News-Record Construction Cost Index for Atlanta, Georgia.

QUANTITY AND QUALITY OF WATER AVAILABLE FOR WATER SUPPLIES

SURFACE WATER

A description of the major streams in the Basin has been included in the INTRODUCTION of these memoranda. Since construction of Clark Hill and Hartwell Dams, flows in the main stem of the Savannah River have been regulated from Augusta to the mouth. The minimum allowable flow at Augusta is assured at 5800 cfs.

The availability of data on surface water quality in the Basin was good, especially in the upper portion of the Basin above the headwaters of the Clark Hill Reservoir and between Augusta and Clark Hill Dam. Data were available at 39 stations within the Basin, 26 of which were located above the headwaters of Clark Hill Reservoir, 8 between Clark Hill Dam and Augusta, and 5 in the lower portion of the Basin. The data, which are found in the report Water Quality Basic Data - Southeast River Basins, 1961 prepared for the U. S. Study Commission by the Public Health Service, show that the average dissolved oxygen reported at all stations consistently exceeded 75 percent of saturation. Total dissolved solids reported above Clark Hill Dam ranged from 19 to 51 parts per million (ppm) and below the dam from 34 to 122 ppm. Hardness reported in the upper portion of the Basin ranged from 8 to 32 ppm, whereas the hardness reported at the stations below Clark Hill Dam ranged from 12 to 62 ppm. Calcium and other mineral constituents reported at stations above the dam were less than those reported below. Eleven of the stations reported iron concentration in excess of 0.3 ppm.

To supplement existing surface water quality data, a sampling station was established in the Basin on the Savannah River below Augusta by the Public Health Service and field studies were conducted during November 1960, January and February 1961, and June 1961. The average dissolved oxygen reported during the study consistently exceeded 75 percent of saturation. Total organic nitrogen was less than 0.5 ppm and total phosphates appeared insignificant. The median concentration of coliform organisms ranged from 12,150 to 23,000 Most Probable Number (MPN) per 100 ml with a maximum of 93,000 reported during the winter. The beta radioactivity of the water during the summer was relatively high, ranging from 16.6 to 194.3 micro-microcuries per liter (uuc/l) for the dissolved fraction. The alpha activity during this same period was also high with a value of 13.9 uuc/l being reported for the dissolved fraction. Average alkalinity ranged from 14.1 to 20.8 ppm.

GROUND WATER

In the Savannah Basin available ground water is scarce in the Blue Ridge Province, somewhat more abundant in the Piedmont Province, and plentiful in the Coastal Plain Province. The five municipalities in the Blue Ridge Province all obtain water from springs or surface supplies. Of the 42 municipalities in the Piedmont Province, 13 obtain water from surface sources. Yields of drilled municipal wells in the Piedmont Province range from 10 gallons per minute (gpm) to 250 gpm and the average yield of the 34 municipal wells for which data were obtained was 118 gpm. In the Coastal Plains Province, wells draw upon the Cretaceous and limestone aquifers and yield from 100 gpm to 1500 gpm. The average yield of the 16 municipal wells in this Province for which data were available was 440 gpm.

Chemical and physical analyses of ground water were available at 69 stations throughout the Basin as shown in the report on Water Quality Basic Data - Southeast River Basins. Generally, ground water is of such quality that little or no treatment would be necessary to comply with the chemical requirements of the Public Health Service "Drinking Water Standards." There are a few local areas in the Basin, however, where treatment would be necessary. In the Blue Ridge Province, available data indicate that problems exist in Rabun County Georgia, due to low pH, and in Pickens County, South Carolina, due to high iron content. In the Piedmont Providence, problems of high iron content appear in Hart, Madison, and Elbert Counties, Georgia, and high total dissolved solids are found in Wilkes County, Georgia. Low pH values occur in Anderson, Aiken, and Barnwell Counties, South Carolina. Excessive amounts of calcium and sulfate appear in the ground water in Wilkes County, Georgia, and excessive amounts of fluoride appear in Oglethorpe County, Georgia. The data indicate excessive hardness in Elbert and Wilkes Counties, Georgia. In the Coastal Plains Province the only problems appears to be low pH values in Richmond County, in the area of Augusta and high total hardness in the area of the City of Savannah.

Salt water intrusion in the limestone aquifer at Savannah, Georgia, is a cause of increasing concern to water users. However, a recent study by the U. S. Geological Survey states: "The lowering of the artesian head has caused highly mineralized water in the lower part of the aquifer to start moving toward Savannah. However, chemical quality of water pumped from the artesian aquifer has changed little since the first wells were drilled."

"At the present rate of pumping of about 60 mgd or even at double that rate, many years, perhaps more than a century probably will elapse before water in the aquifer at Savannah becomes salty."

"Savannah and the surrounding area can support additional water using industries if new wells are drilled to the northwest, west, and southwest of the city outside the present industrial area."

MUNICIPAL WATER SUPPLIES

INVENTORY

There are 122 communities in the Savannah Basin which are served by municipal water supply systems. However, only 106 systems serving 112 communities obtain water from sources within the Basin and only these are included in this report. The six systems with "outside" sources serve Commerce, Mt. Airy, and Winterville in Georgia, and Greenwood, Easley, and Johnston in South Carolina. Information concerning water supply systems of the three "outside" Georgia municipalities may be found in other SERB area memoranda. Twenty-four of the 106 water systems use surface water as the source of municipal supplies, four use both surface and ground water, and the remainder use ground water only (Table W-1).

The total population of the Savannah Basin in 1960 was 731,700. The 106 water systems obtaining water from within the Basin served 448,470 persons and the 6 "outside" systems served 39,700 in the Basin. In addition, the Savannah municipal system served approximately 55,000 persons in the Ogeechee Basin. Average water demand of the 106 systems shown in Table W-1 is 87.5 mgd or 170 gpcd. Industries which depend on municipal systems for water supply consume 36.2 mgd or 41.3 percent of the total municipal system output.

PRESENT STATUS OF WATER SUPPLY SYSTEMS

Thirty-four of the water supply systems are privately owned and 72 are publicly owned. All plants have periodic bacteriological examinations made of the water supplied to the public. Fifty-four systems use chlorine to disinfect the water supplied to their users. The other systems have supplies which have proven bacteriologically satisfactory up to the present time without disinfection. Twenty-seven plants have filtration systems, 26 have corrosion control, 3 have iron removal, and 4 plants provide fluoridation.

At the present time there appear to be no major water treatment problems in the Basin. High iron content in some water supply sources is removed satisfactorily. Anderson, South Carolina obtains its water from Rocky River and Beaverdam Creek, and these streams have not been classified by the South Carolina State Board of Health as suitable sources for domestic use after complete treatment. The effect on water supplies of occasional high radioactivity counts in the Savannah River below the AEC plant has not been determined. Low pH values (below 5.6) have been detected in water supplies of Bath and Langley, South Carolina.

WATER SUPPLY SYSTEM REQUIREMENTS FOR 1960

Although 46 municipalities reported that improvements were needed on their present water supply systems, a study of the basic data indicates that 70 of the water supply systems have source, treatment, storage, or distribution system inadequacies.

The recommended improvements, as shown by Table W-2 in terms of costs, include wells for 3 communities, disinfection for 54, iron removal for 1, storage facilities for 21, corrosion control for 1, high service pumps for 3, plant enlargements for 2, improved intake facilities for 2, and distribution system extensions to serve 10,500 persons in 20 municipalities.

FUTURE WATER SUPPLY SYSTEM REQUIREMENTS

Table W-3 shows the projected municipal water demands for 1975. It is anticipated that most subdivisions shown in the 1960 inventory will have been incorporated into adjacent cities by 1975. The 83 municipal water systems obtaining water from sources within the Basin will have an estimated total water demand of 148.224 mgd and will serve an estimated 681,115 persons. Water supply system improvements in addition to those listed as being needed in 1960 will be required to adequately serve this population between 1960 and 1975. A study of the basic data indicates that surface source facilities (impoundments, intakes, etc.) will be required for 7 systems, wells for 9, disinfection equipment for 9, treatment plant construction (new or additions to existing facilities) for 7, elevated storage for 11, and expansion of distribution systems to serve an estimated 183,900 persons in 51 communities.

Table W-4 shows the projected municipal water demands for the year 2000. By the year 2000, the 83 municipal water supply systems obtaining water from sources within the Basin will have an estimated total water demand of 293.61 mgd and serve an estimated 1,189,800 persons. A study of the basic data indicates that additional improvements will be required for 15 surface source facilities, wells will be required for 16 systems, disinfection equipment for 16, new treatment plant construction or additions for 17, elevated storage for 29, and expansion of distribution systems to serve an estimated population of 485,200 persons in 53 communities.

FUTURE WATER SUPPLY PROBLEMS

A large and deep cone of depression exists in the limestone aquifer at Savannah, Georgia. As previously stated in the "Ground

Water" section, salt water intrusion should not become critical for many years even with increased ground water withdrawal. However, in order to provide a safety factor it was assumed that surface sources would be used to meet the greatly increased water demand after 1975. Adequate quantities of surface water are available at Savannah to meet the anticipated future demands.

The possibility of contamination of Beaver Dam Creek which is the water supply source of Elberton, Georgia, should be a future consideration. At present, a portion of the waste from Royston, Georgia, is discharged into Beaver Dam Creek less than twenty miles upstream from the Elberton water plant intake. Studies should be conducted to determine the extent of pollution.

ANNUAL COSTS

The annual cost of providing water to municipal users in the Savannah Basin in 1960 is estimated to be $7,392,300. This cost, based on the cost of existing facilities, is broken down as follows:

Annual equivalent capital cost	$2,879,000
Annual replacement cost	51,100
Annual operation and maintenance cost	4,462,200
Total annual cost (1960)	$7,392,300

The total capital outlay required to improve existing municipal water supply facilities in 1960 is estimated to be $2,079,000 as shown by Table W-2. The expenditure of this amount of money will strengthen the existing municipal water systems of the Basin and provide adequate service.

Between 1960 and 1975, additional expenditure will be necessary to improve water supply systems and meet the demands of the increased number of users. The capital cost of providing the additional necessary improvements by 1975 is estimated to be $15,753,000 as shown by Table W-3. This includes $2,782,000 for improvement of sources and treatment, $1,937,000 for storage facilities, and $11,034,000 for distribution facilities.

The annual cost of providing water to municipal users in 1975 is estimated to be $11,140,600. This includes annual equivalent capital cost of: (1) existing facilities in 1960, (2) facilities recommended to meet 1960 needs, and (3) facilities recommended to meet additional needs between 1960 and 1975. The replacement cost is based on total investment as of 1975, and the operation and maintenance cost is based on the total installed systems as of 1975. A breakdown of this annual cost is given below.

Annual equivalent capital cost	$ 3,644,400
Annual replacement cost	74,600
Annual operation and maintenance cost	7,421,600
Total annual cost (1975)	$11,140,600

Between 1975 and 2000 municipal growth will make necessary an additional estimated capital expenditure of $50,448,000 to raise water supply facilities to the necessary capacity. This includes $13,855,000 for source improvement and treatment facilities, $7,480,000 for storage capacity, and $29,113,000 for extension of distribution facilities.

The annual cost of providing water to municipal users by 2000 is estimated to be $20,145,400 assuming that all needs have been met by the year 2000. A breakdown of this annual cost is given below:

Annual equivalent capital cost	$ 6,093,700
Annual replacement cost	90,700
Annual operation and maintenance cost	13,961,000
Total annual cost (2000)	$20,145,400

BENEFITS

Storage for municipal water supply is frequently one of the purposes served by the development of multi-purpose river basin projects. The cost of developing alternative sources of water supplies most likely to be used in the absence of the project normally provides a measure of the benefits to water supply storage. For most areas of the Basin it may be assumed that water supplies necessary to meet the demands could be obtained from ground water. Where sufficient ground water is not available other alternative sources of surface water have been used in this memorandum.

Because there is no established market value for water as a commodity sold in a competitive market, monetary benefits from water supplies not used or anticipated to be used in the future, from public or private supplies in the Basin, are indeterminate. In common practice, the value of water supplies for which no market values are clearly established is estimated from the cost of providing supplies by the least costly, most likely means. Therefore, the benefits are assumed to be equal to the cost of obtaining water by the least costly alternative means. In this memorandum, benefits from water supply storage specifically for municipal use included in any multi-purpose project constructed in the Basin would be at least equal to the cost of developing alternative sources.

TABLE W-1
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
GEORGIA									
Appling (unincorp.)	100	100	spring	none	--	0.001	0.004	40	
Augusta	70,626	93,230	Savannah R	CalTmbpNgDc-SFrsDcKpVs	30.000	14.950	10.140	110	12.8
Fort Gordon Army Base	15,604	(served by Augusta)							
Edgewood S/D	150	150	well	none	0.096	0.001	0.015	100	
Baldwin	698	670	wells	none	2.600	0.185	0.025	38	29.0
Bowman	654	654	wells	none	0.150	0.050	0.065	100	
Camack	285	240	wells	none	0.039	0.030	0.009	38	
Canon	626	500	well	Dh	0.077	0.035	0.020	40	
Carlton	321	321	wells	Dh	0.144	0.087	0.030	100	
Carnesville	481	481	spring	Dh	0.085	0.005	0.035	73	
Clayton	1,507	1,745	Blacks Cr	CasScFspDc	0.820	0.500	0.360	200	3.0
Colbert	425	475	wells	Dh	0.025	0.033	0.020	42	
Comer	882	880	wells	none	0.216	0.045	0.046	53	7.6
Crawford	541	596	Long Cr	CalMbSbFrsDc	0.250	0.670	0.060	100	
Danielsville	362	392	wells	DhCs	0.470	0.090	0.016	40	
Dearing	403	411	well	Dh	0.130	0.100	0.025	60	20.0
Elberton	7,107	8,001	Beaver Dam Creek	CalMbFrsKpDcV	2.000	1.900	1.200	150	2.8
Garden City	5,451	5,451	wells	none	1.650	0.065	0.200	45	4.0
Grovetown	1,396	1,336	wells	none	0.288	0.055	0.065	48	
Harlem	1,423	1,431	wells	KcpMiScDc	0.140	0.195	0.125	88	5.0
Hartwell	4,599	4,699	Lightwood Log Cr	DcCalsMbShFrs	1.000	0.480	0.600	128	33.0
Hephzibah	676	676	well	KpCsDh	0.144	none	0.045	67	
Mine Village	100	100	wells	none	0.050	0.002	0.005	50	
Homer	612	235	wells	none	0.180	0.100	0.020	85	15.0
Ila	216	200	well	Dh I	0.180	0.080	0.009	45	
Lavonia	2,088	2,388	wells	none	1.000	0.225	0.158	66	30.0
Lexington	376	406	wells	KpDc	0.865	0.060	0.025	62	
Lincolnton	1,450	1,550	wells	none	4.200	0.140	0.125	81	12.0
Lula	557	510	well	CsMbSbDh	0.103	0.067	0.035	69	
Martinez - Lamkin (Uninc.)	3,800	2,400	well	none	0.350	0.002	undet.	undet.	
Maysville	553	680	well	Dc	0.087	0.065	0.045	66	45.0
Newington	399	399	wells	none	0.115	0.150	0.030	75	
Pooler	1,073	1,500	well	none	0.430	0.015	0.080	53	

(11/1/61)

TABLE W-1 (CONT'D)
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
GEORGIA - cont'd									
Port Wentworth	3,705	3,085	wells	Dh	1.400	0.055	0.160	52	5.0
Sawmill Village	225	225	well	none	0.087	0.075	0.018	80	
Sugar Refinery Village	325	325	well	none	0.720	0.050	0.020	62	
Richmond County	--	15,200	wells	ClMpKpDc	1.500	0.065	1.000	66	
Rincon	1,057	850	well	none	0.072	0.065	0.054	64	
Royston	2,333	2,403	wells	Dc	0.330	0.110	0.125	135	50.0
Sardis	829	812	wells	Dh	0.750	0.095	0.080	100	
Savannah(part)	--	150,000[1]	wells	Dc	45.000	undet.	15.000	100	
			Abercorn Cr	DcCalMbpSoFrsDcKp	50.000	14.000	30.400	--	99.0
Lakeside Park S/D	360	360	wells	none	undet.	0.010	0.032	89	
Parkersburg S/D	600	600	wells	none	0.600	0.010	0.050	83	
Wymberley S/D	700	700	wells	none	undet.	0.010	0.063	90	
Wymberley on the Marsh S/D	90	90	well	none	0.430	0.002	0.009	100	
Wilmington Park S/D	240	240	well	Dh	undet.	0.005	0.021	88	
Rio Vista S/D	180	180	well	Dh	0.600	0.004	0.016	80	
Savannah Beach	1,385	1,385	wells	none	3.600	0.100	0.100	72	
Shawnee (Unincorp.)	65	65	wells	none	0.144	0.001	0.003	45	
Springfield	858	860	wells	Dh	0.800	0.065	0.031	36	
Sylvania	3,469	3,400	wells	none	1.750	0.250	0.500	147	1.0
Tallulah Falls	225	50	springs	none	undet.	none	0.005	100	
Thomson	4,522	4,972	Usry Pond	DcCalTcMbSbFraKp	1.000	0.400	0.500	100	3.0
Thunderbolt	1,925	2,005	wells	none	1.370	0.100	0.160	78	2.0
Tignal	556	568	wells	none	0.130	0.060	0.070	123	
Toccoa	7,303	8,000	Reservoir	CalDcMpbSb	4.500	0.840	3.000	375	50.0
Tugalo Village (Unincorp)	75	75	Spring	FraKpNgDc	0.144	0.014	0.008	100	
Washington	4,440	4,890	Beaverdam Cr	CalTcDxMbSoFrsKpDc	1.000	0.480	0.694	142	29.0
Waynesboro	5,359	5,420	Briar Cr	CaMbSbFrsDc	1.000	0.625	0.700	129	
Wrens	1,628	1,620	wells	none	0.500	0.060	0.093	58	14.0

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TABLE W-1 (CONT'D)
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
SOUTH CAROLINA									
Abbeville	5,436	6,000	Rocky R & Long Cane Cr	CaDcMtpSo-FraDcKp	3.000	1.250	1.700	283	50.0
Aiken	11,243	18,000	Shaw Cr and Shiloh Spr	DcCalMbSo-FrsKpVt	4.100	2.370	1.570	87	
			well	KpVt	0.400				
Briar Cliff Acres S/D	80	80	well	none	2.260	0.075	0.008	100	
Gloverville Valley S/D	300	300	wells	F	0.500	0.075	0.030	100	
College Acres S/D	700	700	wells	Dh	0.290	0.050	0.025	36	
Anderson (Equinax Mills, Orr Mill, Toxaway)	41,316	40,000	Rocky R and Black R and Bailey Cr and Beaverdam Cr	CalMbSbFrs-DcKp	13.000	2.363	4.500	112	4.5
Bath (Unincorp.)	1,419	1,300	wells	Kcp	0.860	0.100	0.181	139	
Belton	5,106	5,800	wells	none	0.600	0.350	0.400	69	
Calhoun Falls	2,525	1,600	wells	none	0.187	0.075	0.125	78	
Cateechee (Unincorp.)	600	600	wells	I DhKc	2.000	0.060	0.145	240	6.0
Central	1,473	2,500	18 Mile Cr	CasTcMbSo-FrsDc	0.250	0.150	0.190	76	
Clearwater (Unincorp.)	1,450	1,400	Little Horse Creek	DcCasMtSo-FrsKc	5.000	0.348	3.800	270	70.0
Belcher Hts. S/D	200	200	wells	none	0.284	none	0.005	25	
Clemson	1,587	--	Clemson College	DcNgCasTeMb-SoFrasKpsDc					
Clemson College	4,000	10,000	Seneca R.		1.500	1.850	1.100	110	
Donalds	416	400	wells	none	0.500	0.002	0.075	187	
Due West	1,166	1,200	wells	none	0.500	0.050	0.150	125	
Edgefield	2,876	2,750	Slade Lake & wells	CasDcMpSb-TcFrsDcKp	0.665	0.375	0.175	64	
Gluck Village (Unincorp.)	750	750	Spring	Dc	0.200	0.080	0.150	200	
Graniteville (Vauduse, Warrenville)	1,017	5,000	Horse Cr and Springs	CasToMpSv-FrsDcKc	1.370	0.375	0.530	106	
Greenwood									
Panola Mill	500	500	wells	none	1.300	undet.	0.130	260	61.0

TABLE W-1 (CONT'D)
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
SOUTH CAROLINA - cont'd.									
Chinaquapin S/D	100	100	wells	none	1.200	undet.	0.010	100	
Stalmaker Hts. S/D	120	120	well	none	0.072	undet.	0.005	42	
Woodfield S/D	360	360	wells	none	1.300	undet.	0.050	140	
Hardeeville	700	1,200	well	none	0.288	0.075	0.040	33	
Honea Path	3,453	5,400	wells	DhKp	0.470	0.220	0.202	38	
Iva (Jackson Mill Vill.)	1,357	1,900	wells	none	0.208	0.100	0.075	40	
Jackson	1,746	1,500	well	DcKc	0.500	0.125	0.040	27	
La France (Unincorp.)	847	1,200	23 Mile Cr	CasDcSo-FraDcKp	1.000	0.276	1.000	83	
Langley	1,216	1,600	Spring & well	none	0.300	0.125	0.100	63	
Liberty	2,657	3,500	18 Mile Cr	DcCasMbSo-FrsKcp	1.250	0.620	0.450	128	
McCormick	1,998	1,800	Clark Hill Res	CasDcMbSoFrs	0.500	0.180	0.250	139	
New Ellenton	2,309	4,300	well	IKCp	0.720	0.100	0.400	93	
Newry (Unincorp.)	762	1,000	wells	none	0.500	0.096	0.100	100	
North Augusta	10,348	15,000	Springs and Savannah R	DcCalMtSo-FrsKcpDc	2.000	1.650	0.750	50	
Belvedere Ridge S/D	1,200	1,200	well	none	0.300	0.190	0.070	58	
Pendleton	2,358	2,500	wells	none	0.250	0.075	0.110	43	
Pickens	2,198	3,000	12 Mile Cr	DcCasMbFrs-KpDc	1.500	0.575	0.500	166	
Pickens Mill	795	800	Town Cr	CasMbSoFrsDc	0.168	0.120	0.053	69	
Scotia	102	100	well	none	0.010	none	0.004	40	
Seneca (Londsdale, Utica)	5,227	8,500	Thompson Cr and Cane Cr and Little R	DcCalMbSo-FrsDcKp	1.000	0.665	0.650	77	
Royal Acres S/D	20	20	well	none	0.040	0.001	0.001	50	
Morningside Hts. S/D	80	80	wells	none	0.010	0.001	0.002	25	
Trenton	314	400	wells	none	0.029	0.060	0.007	18	

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TABLE W-1 (CONT'D)
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
SOUTH CAROLINA - cont'd									
Walhalla (West Union)	3,431	4,000	Reservoir and Chauga R	CaMbFrsDc	0.675	0.325	0.375	94	
Morningside Hts. S/D	120	120	wells	none	1.370	0.001	0.005	42	
Westminster	2,413	3,500	Ramsey Cr	DcCasMbSbFrs	1.500	1.650	0.750	214	
Total		503,467					87.535	170	41.3

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[1] Includes 55,000 in Ogeechee Basin.

TABLE W-2
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

Municipality	Estimated Costs in $1,000				
	Source	Treatment	Storage	Dist. System	Total
GEORGIA					
Appling	--	2	--	--	2
Augusta					
Edgewood S/D	--	2	10	--	12
Baldwin	--	4	--	2	6
Bowman	--	4	--	--	4
Camack	--	4	--	3	7
Canon	--	--	--	8	8
Carnesville	--	--	18	--	18
Comer	--	4	--	--	4
Crawford	--	--	60	--	60
Garden City	--	8	35	--	43
Grovetown	12	8	27	4	51
Hartwell	12	--	--	--	12
Hephzibah	--	--	27	--	27
Mine Village	--	6	--	--	6
Homer	--	4	--	23	27
Lavonia	--	16	--	--	16
Lincolnton	--	8	--	--	8
Lula	--	--	--	3	3
Martinez-Lamkin	12	8	82	84	186
Newington	--	4	27	--	31
Pooler	--	8	27	--	35
Port Wentworth	10	--	82	37	129
Sawmill Village	5	2	--	--	7
Sugar Refinery Village	--	2	--	--	2
Rincon	--	8	--	12	20
Royston	6	115	--	--	121
Sardis	--	--	35	--	35
Savannah					
Lakeside Park S/D	--	4	--	--	4
Parkersburg S/D	--	4	25	--	29
Wymberly S/D	--	4	25	--	29
Wymberly on the Marsh S/D	--	2	--	--	2
Wilmington Park S/D	--	--	10	--	10
Savannah Beach	--	8	--	--	8
Shawnee	--	2	--	--	2
Sylvania	--	8	--	6	14
Tallulah Falls	--	2	22	11	35

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TABLE W-2 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

	Estimated Costs in $1,000				
Municipality	Source	Treatment	Storage	Dist. System	Total
GEORGIA (Cont'd)					
Thunderbolt	--	8	--	--	8
Tignal	--	6	--	--	6
Toccoa	--	--	--	130	130
Tugalo Village	--	2	--	--	2
Washington	10	--	132	--	142
Wrens	--	8	--	--	8
SOUTH CAROLINA					
Aiken					
Briar Cliff Acres S/D	--	2	--	--	2
Gloverville Valley S/D	--	4	--	--	4
Anderson	--	--	--	90	90
Bath	--	8	--	7	15
Belton	--	8	--	--	8
Calhoun Falls	--	8	--	54	62
Central	--	65	--	--	65
Clearwater					
Belcher Hts. S/D	--	4	--	--	4
Clemson & Clemson College	--	--	132	--	132
Donalds	--	2	--	27	29
Due West	--	8	--	--	8
Edgefield	--	--	--	8	8
Gloverville	12	8	35	93	148
Graniteville	--	--	20	--	20
Greenwood					
Panola Mill	--	6	--	--	6
Hardeeville	--	2	--	--	2
Iva	--	8	--	--	8
Jackson	--	--	--	15	15
Langley	--	8	--	--	8
McCormick	--	--	--	12	12
New Ellenton	--	8	48	--	56
Newry	--	16	--	--	16
North Augusta					
Belevedere Ridge S/D	--	8	--	--	8
Pendleton	--	8	--	--	8
Scotia	--	2	18	--	20
Seneca					
Morningside Hts. S/D	--	4	--	--	4

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TABLE W-2 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

Municipality	Estimated Costs in $1,000				
	Source	Treatment	Storage	Dist. System	Total
SOUTH CAROLINA (Cont'd)					
Trenton	--	4	--	--	4
Walhalla					
Morningside Hts. S/D	--	8	--	--	8
Total	79	474	897	629	2,079

* Costs are based on January 1960 constant dollars.

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TABLE W-3
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000 Source and Treatment	Storage	Dist. System	Total
GEORGIA						
Appling	100	0.004	--	--	--	--
Augusta (Ft. Gordon)	100,080	16.000	--	--	540	540
Baldwin	1,000	0.200	--	--	18	18
Bowman	680	0.068	--	--	2	2
Camack	250	0.025	--	--	--	--
Canon	670	0.067	--	--	2	2
Carlton	300	0.030	--	--	--	--
Carnesville	525	0.053	--	--	3	3
Clayton	2,950	0.455	--	--	132	132
Colbert	460	0.046	14	--	--	14
Comer	850	0.085	--	--	--	--
Crawford	530	0.074	--	--	--	--
Danielsville	380	0.038	--	--	--	--
Dearing	500	0.060	--	--	5	5
Elberton	8,900	1.700	--	--	54	54
Grovetown	1,700	0.255	--	35	18	53
Harlem	1,900	0.300	44	--	28	72
Hartwell	6,900	1.370	121	--	132	253
Hephzibah	700	0.070	--	--	2	2
Mine Village	100	0.005	--	--	--	--

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TABLE W-3 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
GEORGIA - cont'd						
Homer	950	0.110	--	--	20	20
Ila	200	0.020	--	--	--	--
Lavonia	2,450	0.480	--	--	4	4
Lexington	350	0.035	--	--	--	--
Lincolnton	1,800	0.300	--	--	15	15
Lula	750	0.075	--	--	12	12
Martinez-Lamkin	3,000	0.600	20	70	--	90
Maysville	575	0.084	--	--	--	--
Newington	410	0.041	--	--	1	1
Pooler	1,550	0.230	--	27	3	30
Richmond County	75,000	11.250	1400	950	3588	5938
Rincon	1,900	0.285	44	--	51	95
Royston	3,000	0.670	121	70	36	227
Sardis	1,000	0.150	--	--	12	12
Savannah	230,000	65.000	--	--	3340	3340
Savannah Beach	2,200	0.330	--	--	54	54
Shawnee	65	0.003	--	--	--	--
Springfield	1,250	0.190	--	--	24	24
Sylvania	4,800	0.720	--	--	78	78
Tallulah Falls	250	0.025	--	--	2	2

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TABLE W-3 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
GEORGIA - cont'd						
Thomson	7,000	1.050	--	--	120	120
Tignal	590	0.059	--	--	2	2
Toccoa	9,100	3.400	--	82	66	148
Tugalo Village	100	0.010	--	--	--	--
Washington	5,200	1.000	--	--	48	48
Waynesboro	6,200	0.930	--	--	48	48
Wrens	2,000	0.340	--	35	23	58
SOUTH CAROLINA						
Abbeville	6,100	2.700	--	--	6	6
Aiken	13,800	2.250	--	--	--	--
Anderson	63,200	13.800	--	544	1392	1936
Belcher Heights S/D	200	0.005	--	--	--	--
Belton	9,200	1.380	218	--	202	420
Calhoun Falls	3,000	0.450	56	41	30	127
Cateechee	600	0.150	--	--	--	--
Central	1,550	0.232	--	--	--	--
Clearwater	1,450	3.800	--	--	--	--
Clemson & Clemson College	7,200	1.430	--	--	36	36
Donalds	600	0.060	--	--	12	12

(11/1/61)

TABLE W-3 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
SOUTH CAROLINA - cont'd						
Due West	1,600	0.240	--	35	24	59
Edgefield	3,300	0.500	--	--	24	24
Gloverville	1,550	0.230	--	--	--	--
Gluck Village	750	0.150	--	--	--	--
Graniteville	4,700	0.705	--	--	--	--
Hardeeville	1,200	0.180	--	--	--	--
Honea Path	3,900	0.585	20	--	--	20
Iva	1,400	0.210	--	--	--	--
Jackson	1,800	0.270	--	--	3	3
LaFrance	1,200	1.000	--	--	24	24
Langley	2,500	0.370	--	--	--	--
Liberty	3,000	0.450	--	--	--	--
McCormick	2,500	0.375	--	--	36	36
New Ellenton	2,300	0.345	--	--	--	--
Newry	1,000	0.150	--	--	--	--
North Augusta	21,100	3.160	308	--	360	668
Panola Mill	500	0.130	--	--	--	--
Pendleton	3,500	0.525	68	48	60	176
Pickens	3,100	0.465	--	--	6	6
Pickens Mill	3,000	0.450	120	--	132	252
Scotia	100	0.015	14	--	--	14
Seneca	11,300	1.695	200	--	168	368

(5/1/62)

TABLE W-3 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SAVANNAH BASIN

			Estimated Costs in $1,000			
Municipality	Estimated Population Served	Estimated Water Demand mgd	Source and Treatment	Storage	Dist. System	Total
SOUTH CAROLINA - cont'd						
Trenton	350	0.035	14	--	--	14
Walhalla	4,600	0.690	--	--	6	6
Westminister	2,800	0.750	--	--	--	--
Total	681,115	148.224	2782	1937	11,034	15,753

*Costs based on January 1960 constant dollars.

(5/1/62)

TABLE W-4
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
GEORGIA						
Appling	100	0.004	9	--	--	--
Augusta (Ft. Gordon)	117,880	24.900	--	--	1,080	1,080
Baldwin	1,875	0.480	--	--	52	52
Bowman	725	0.110	--	--	3	3
Camack	200	0.030	--	--	--	--
Canon	750	0.115	14	--	5	19
Carlton	225	0.035	--	--	--	--
Carnesville	600	0.090	14	25	4	43
Clayton	3,675	0.760	--	--	44	44
Colbert	470	0.070	14	--	--	14
Comer	750	0.115	--	--	--	--
Crawford	480	0.100	--	--	--	--
Danielsville	475	0.070	--	--	5	5
Dearing	765	0.135	--	--	16	16
Elberton	13,000	3.300	307	--	186	493
Grovetown	2,300	0.460	40	58	36	134
Harlem	3,150	0.660	28	--	75	103
Hartwell	13,600	3.600	387	82	402	871
Hephzibah	750	0.115	--	27	3	30
Mine Village	100	0.005	--	--	--	--
Homer	1,600	0.370	32	--	39	71

(11/1/61)

TABLE W-4 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
GEORGIA (Cont'd)						
Ila	150	0.020	--	--	--	--
Lavonia	3,250	0.850	--	--	48	48
Lexington	225	0.045	--	--	--	--
Lincolnton	2,600	0.590	--	35	48	83
Lula	1,000	0.200	32	--	15	47
Martinez-Lamkin	4,000	0.800	20	48	--	68
Maysville	650	0.145	--	--	--	--
Newington	450	0.070	--	--	2	2
Pooler	2,900	0.580	20	58	81	159
Richmond County	250,000	50.000	5,000	2,700	10,500	18,200
Rincon	5,000	1.000	68	82	186	336
Royston	4,700	1.400	121	82	102	305
Sardis	1,300	0.260	--	--	18	18
Savannah	371,000	120.000	3.000	1,904	7,240	12,144
Savannah Beach	4,500	0.900	--	70	138	208
Shawnee	65	0.003	--	--	--	--
Springfield	1,800	0.360	--	41	33	74
Sylvania	8,400	1.680	--	82	216	298
Tallulah Falls	325	0.050	--	--	6	6
Thomson	14,700	2.940	387	132	462	981
Tignal	650	0.100	--	--	4	4

(5/1/62)

TABLE W-4 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000 Source and Treatment	Storage	Dist. System	Total
GEORGIA (Cont'd)						
Toccoa	13,200	5.000	115	202	426	743
Tugalo Village	100	0.015	--	--	--	--
Washington	6,900	1.800	218	--	102	320
Waynesboro	8,000	1.600	236	--	108	344
Wrens	2,700	0.610	20	48	42	110
SOUTH CAROLINA						
Abbeville	7,300	3.150	--	--	72	72
Aiken	18,000	3.600	--	--	--	--
Anderson	107,500	21.500	1,100	690	2,658	4,448
Belcher Hts. S/D	200	0.005	--	--	--	--
Belton	17,800	3.560	463	202	516	1,181
Calhoun Falls	4,100	0.820	112	82	66	260
Cateechee	600	0.150	--	--	--	--
Central	1,650	0.330	--	--	--	--
Clearwater	1,450	3.800	--	--	--	--
Clemson & Clemson College	10,900	2.960	308	--	102	410
Donalds	1,000	0.200	--	35	24	59
Due West	2,800	0.560	--	48	72	120
Edgefield	4,300	0.860	65	--	60	125
Gloverville	1,550	0.300	--	--	--	--

(5/1/62)

TABLE W-4 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SAVANNAH BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
SOUTH CAROLINA (Cont'd)						
Gluck Village	750	0.150	--	--	--	--
Graniteville	4,100	0.820	--	--	--	--
Hardeeville	1,200	0.240	--	--	--	--
Honea Path	4,700	0.940	44	48	--	92
Iva	1,500	0.300	--	--	--	--
Jackson	2,000	0.400	--	--	12	12
La France	1,200	1.000	--	--	--	--
Langley	2,200	0.440	--	--	--	--
Liberty	3,600	0.720	--	--	6	6
McCormick	3,600	0.720	70	48	66	184
New Ellenton	2,300	0.460	--	35	--	35
Newry	1,000	0.200	--	--	--	--
North Augusta	64,000	9.600	905	404	2,580	3,889
Pendelton	7,000	1.400	112	82	210	404
Pickens	5,400	1.080	--	--	138	138
Pickens Mill	3,000	0.600	--	41	132	173
Scotia	100	0.020	--	--	--	--
Seneca	20,600	4.120	460	41	558	1,059
Trenton	500	0.075	14	--	6	20
Walhalla	6,300	1.260	120	48	102	270
Westminster	3,600	0.720	--	--	6	6
Totals	1,189,835	293.612	13,855	7,480	29,113	50,448

*Based on January 1960 constant dollars.

(5/1/62)

DOMESTIC WATER SUPPLIES

INVENTORY

The methods for obtaining basic data on domestic water supply systems have been outlined previously in the "Procedures and Investigations" section of this memorandum.

The estimated 1960 population in the Basin served by existing municipal water supply systems is 488,170. The remainder of the Basin population of 243,530 persons is served by domestic water supply systems. Average per capita water demand is 50 gallons per day which indicates a total existing domestic water demand of 12.2 mgd.

PRESENT STATUS OF WATER SUPPLY SYSTEMS

Based on the analysis of the SERB area wide random-sample survey of domestic supplies, it is estimated that there are 54,120 domestic water supply systems in the Savannah Basin. Of this total, 18,800 systems have drilled wells, 26,100 have dug wells, 2,840 bored wells, 3,450 driven wells, and 2,930 have springs.

It is estimated that 4,400 systems have an insufficient source of supply and another 11,200 have sources with improper construction. There are 38,700 supplies which have pressure systems and of the remaining 15,420 supplies, 13,400 use hand pumps and 2,020 use buckets. There are 32,800 systems which do not meet accepted health standards and 14,300 systems have water quality problems, the most significant of which are hardness and high iron concentrations.

WATER SUPPLY SYSTEMS REQUIREMENTS FOR 1960

In order to provide a safe, potable supply of water for human consumption, certain minimum improvements will be needed for many of the existing domestic systems. These improvements consist of development of new sources for those systems which have either insufficient yield or sources of improper construction. Systems which presently use hand pumps or buckets should install pressure systems and those systems which do not meet health standards because of improper construction will need seals and covers. Softening or other treatment of those sources which have water quality problems is also needed. In addition, approximately 10,500 persons now served by domestic systems should connect to municipal water supply systems. Costs for providing these needs are listed below.

Total capital outlay to improve existing domestic water supply systems to accepted health standards is estimated to be

Annual equivalent capital cost	$3,951,100
Annual replacement cost	1,871,400
Annual operation and maintenance cost	920,200
Total annual cost (1975)	$6,742,700

The annual cost of providing water from the domestic systems expected to exist in 2000 is estimated to be $7,440,100 based on an estimated total investment of $89,851,100. The breakdown of the annual cost for the year 2000 is as follows:

Annual equivalent capital cost	$4,363,200
Annual replacement cost	2,066,600
Annual operation and maintenance cost	1,010,300
Total annual cost (2000)	$7,440,100

INDUSTRIAL WATER SUPPLIES

INVENTORY

Data secured by field surveys of 73 industrially-owned water systems are shown in Table W-5. Only those industries with their own source of water were surveyed, although 22 of the industries shown in Table W-5 supplement their supplies with water from municipal water systems. The 73 industries surveyed use 200.215 mgd from their own sources, and the total amount of water supplied to all industries by municipal systems is 36.2 mgd as shown in the "Municipal Water Supplies" section of this memorandum. Thus, the total industrial water use in the Basin is approximately 236.415 mgd. The pulp and paper industry is the largest user of water. The five pulp and paper plants use 144.1 mgd. The largest single use is 117.7 mgd by a pulp and paper plant at Savannah. Twenty-three of the 73 industries surveyed were textile plants and they use 16.1 mgd.

PRESENT STATUS OF WATER SUPPLY SYSTEMS

Fifteen of the industries surveyed obtain water (not including that from municipal systems) from surface sources only, 49 obtain water from wells only, and 9 obtain water from both wells and surface sources. The total use from wells is 57.635 mgd and the total use from surface sources is 142.580 mgd. No industry reported that the existing source of water was inadequate to meet demands.

Five of the industries provide complete treatment and 3 others provide disinfection only for water used for drinking and sanitation. Two soften the water, and 1 industry treats for corrosion control. Thirty-seven industries reported treatment treatment of water used for processing and boiler use. Process and boiler water was softened at 26 of the plants, 8 of the plants used complete treatment, and 6 treated for corrosion control. One plant disinfected water used for processing. Twelve plants reported treating water for cooling. Five plants used complete treatment for cooling water, 1 controlled algae, 4 softened, 3 treated for corrosion control, and 3 used disinfection only.

No attempt was made to determine total consumptive water use.

FUTURE WATER SUPPLY REQUIREMENTS FOR 1975 AND 2000

Industrial water use from industrially owned sources by 1975 and 2000 is estimated to be 240.236 mgd and 306.891 mgd respectively. Table W-6 gives the projected water demands and water system needs (in terms of cost) for 1975 and 2000.

Between 1960 and 1975, industrial water supply system needs for existing and new industries will include construction of 6 wells, 5 surface water intake enlargements, 2 treatment plants, additions to 2 softening facilities, and 2 elevated tanks.

Industrial development will have expanded between 1975 and 2000 to the point that water supply system needs will include 34 new wells, 2 treatment plant additions, 5 intake enlargements, 3 softening facility additions, 2 elevated storage tanks, and 1 chlorinator.

FUTURE WATER SUPPLY PROBLEMS

No severe industrial water supply problems both from the standpoint of quantity and quality are expected in the future. Salt water intrusion in the City of Savannah area, as mentioned previously, is not expected to handicap industrial growth since surface water is available in large amounts in the event that intrusion should be detrimental.

Some industries located on tributary streams in the Piedmont Province area may experience some water shortage by 2000. However, development of other water sources should solve this problem satisfactorily.

ANNUAL COSTS

Existing industrial water supply systems are reported to be adequate for 1960 needs. The annual cost of providing industrial water in 1960 from existing supplies is estimated to be $4,692,400. A breakdown of this cost, based on the cost of existing facilities, is given below:

Annual equivalent capital cost	$ 557,100
Annual replacement cost	31,000
Annual operation and maintenance cost	4,104,300
Total annual cost (1960)	$4,692,400

Between 1960 and 1975 additional capital outlay will be required to meet increased demands of industry. The capital cost of the required improvements is estimated to be $4,738,000 as shown in Table W-6.

The annual cost of providing the industrial water required by 1975 is estimated to be $6,187,300. This includes annual equivalent capital costs of existing facilities in 1960, and facilities recommended to meet additional needs between 1960 and 1975. The replacement cost is based on the total investment as of 1975, and the operation and maintenance cost is based on the total installed systems as of 1975. A breakdown of the annual cost is given below:

Annual equivalent capital cost	$ 790,100
Annual replacement cost	35,200
Annual operation and maintenance cost	5,362,000
Total annual cost (1975)	$6,187,300

Between 1975 and 2000 industrial growth will make necessary an additional capital outlay of $5,564,000 to meet the increased water demand as shown in Table W-6.

The annual cost of providing the industrial water needed by 2000 is estimated to be $8,048,800, assuming that all the needs have been met by the year 2000. A breakdown of this cost is given below:

Annual equivalent capital cost	$1,058,800
Annual replacement cost	47,100
Annual operation and maintenance cost	6,942,900
Total annual cost (2000)	$8,048,800

BENEFITS

Storage for industrial water supply is frequently one of the purposes served by the development of multi-purpose river basin projects. The cost of developing alternative sources of water supplies most likely to be used in the absence of the project normally provides a measure of the benefits to water supply storage. For most areas of the Basin it may be assumed that water supplies necessary to meet the demands could be obtained from ground water. Where sufficient ground water is not available other alternative sources of surface water have been used in this memorandum.

Because there is no established market value for water as a commodity sold in a competitive market, monetary benefits from water supplies now used or anticipated to be used in the future, from public or private supplies in the Basin, are indeterminate. In common practice, the value of water supplies for which no market values are clearly established is estimated from the cost of providing supplies by the least costly, most likely means. Therefore, the benefits are assumed to be equal to the cost of obtaining water by the least costly alternative means. In this memorandum, benefits from water supply storage specifically for industrial use included in any multi-purpose project constructed in the Basin would be at least equal to the cost of developing alternative sources.

SUMMARY

1960

The total average water demand of existing (1960) municipal, domestic and industrial water systems whose source is within the Basin is estimated to be 299.950 mgd. There are 106 municipal water systems (serving 503,467 persons) 54,120 domestic water systems (serving 243,530 persons) and 73 industrially-owned water systems. The total annual cost of obtaining water for the municipal, domestic, and industrial systems is estimated to be $15,915,600.

1975

By 1975, the total average water demand of municipal, domestic, and industrial water systems whose source of water is within the Basin is estimated to be 408.860 mgd. The municipal water system will serve 681,115 persons and there will be 67,400 domestic water systems serving 303,300 persons. The total annual cost of obtaining water for the municipal, domestic, and industrial systems is estimated to be $24,070,600 by 1975.

2000

By the year 2000, the total average water demand of municipal, domestic, and industrial water systems whose source of water is within the Basin is estimated to be 637.600 mgd. The municipal water systems will serve 1,189,835 persons and there will be 74,000 domestic water systems serving 333,000 persons. The total annual cost of obtaining water for the municipal, domestic, and industrial systems is estimated to be $35,634,300 by the year 2000.

Water supply sources in the Savannah Basin are expected to be adequate to meet demands in the year 2000 is they are properly developed. Protection from possible pollution will be needed to safeguard the generally good quality water existing in the Basin at the present time.

TABLE W- 5
BASIC DATA ON INDUSTRIAL WATER SUPPLY SYSTEMS
SAVANNAH BASIN

Location by State and County	Code	Type of Industry	Number of Employees	Drinking and Sanitation			Processing and Boiler			Cooling			Total Plant Demand mgd
				Source	Treatment	Average mgd	Source	Treatment	Average mgd	Source	Treatment	Average mgd	
GEORGIA													
Chatham	B	wood pres.	100	city	--	--	Savannah R.	soften	0.030	city	--	--	0.030
	C	pulp & paper	575	city	--	--	City	zeolite	--	Savannah R.	none	6.000	6.000
	E	meat packing	15	well	none	*	well	none	*	well	none	*	0.017
	F	naval stores	180	well	none	0.002	well	soften	0.143	well	none	2.690	2.835
	G	bakery	263	well	none	undet.	well	none	0.024	well	none	0.020	0.044
	H	chemical	28	well	none	*	well	soften	*	well	none	*	0.020
	I	asph. roofing & paper	225	well	none	*	well & city	soften	--	well	none	*	0.630
	J	refinery	99	well	none	0.002	well & city	zeolite	0.498	Savannah R.	none	1.600	2.100
	K	meat packing	300	well	none	*	undet.	none	*	well	none	*	0.004
	L	meat packing	30	well	none	*	well	soften	*	well	none	*	0.108
	M	fertilizer	40	well	none	0.004	well	soften	0.018	well	none	0.400	0.422
	N	fertilizer	50	well	none	*	well	none	*	well	none	*	0.166
	O	chemical	50	city	--	--	well	none	0.005	well	none	0.103	0.108
	P	chemical	330	city	--	--	city	--	--	well & Savan.R.	none	18.600	18.600
	Q	sugar refinery	500	well	none	*	well	soften	*	Savannah R.	none	6.000	7.950
	R	gypsum board	287	well	chlor.	0.014	well	chlor,soften	0.145	well	chlor.	0.100	0.259
	S	pulp & paper	5,100	Savannah R.	complete	0.100	well	soften	27.600	Savannah R.	none	90.000	117.700
	T	meat packing	100	well	none	*	well	soften	*	well	none	*	0.216
	V	meat packing	32	well	none	*	well	soften	*	well	none	*	0.025
	W	asph. roofing & felt	160	well	none	0.002	well	soften	0.223	well	none	0.029	0.254
	Z	chemical	61	well	none	*	well	none	*	well	none	*	0.720
	AA	food-oils	250	well	none	0.037	well	soften	0.059	well	none	1.252	1.347
Elbert	CC	stone cutting (50 plants)	1,250	city	chlor.	--	well	none	0.600	--	--	--	0.600
Hart	FF	mining	18	well	none	0.001	surface	soften	1.440	--	--	--	1.441
	GG	metal products	574	city	--	--	city	--	--	pond	none	0.840	0.840
Lincoln	HH	poultry proc.	15	well	none	*	well	none	*	well	none	*	0.005
McDuffie	KK	textile	175	well	none	*	well	none	*	well	algae control	*	0.025
	LL	garment mfg.	650	city	--	--	pond	soften	0.012	--	--	--	0.012
Screven	NN	meat packing	4	well	none	*	well	none	*	well	none	*	0.010
Stephens	PP	metal products	1,000	well	none	0.018	Lake Louise	pH adj.	0.144	--	--	--	0.162
	QQ	foundry	38	well	none	0.001	Lake Louise	none	*	Lake Louise	none	*	0.087
Richmond	SS	chemical	65	city	--	--	well	soften	*	well	none	*	0.060
	TT	lumber treat.	80	well	soften	*	well	soften	*	well	soften	*	0.216
	UU	textile	300	city	--	--	well	complete	0.120	city	--	--	0.120
	VV	meat packing	8	well	none	*	well	none	*	well	none	*	0.015
	WW	meat packing	65	well	none	*	well	pH adj.	*	well	none	*	0.576

(5/1/62)

TABLE W-5 (CONT'D)
BASIC DATA ON INDUSTRIAL WATER SUPPLY SYSTEMS
SAVANNAH BASIN

Location by State and County	Code	Type of Industry	Number of Employees	Drinking and Sanitation			Processing and Boiler			Cooling			Total Plant Demand mgd
				Source	Treatment	Average mgd	Source	Treatment	Average mgd	Source	Treatment	Average mgd	
GEORGIA (Cont'd)													
Richmond	YY	pulp & paper	58	well	none	undet.	pond	complete	0.500	--	--	--	0.500
	CCC	meat packing	65	well	pH adj.	*	well	pH adj.	*	well	pH adj.	*	0.080
	DDD	brick	600	city & well	none	*	well	none	*	well	none	*	0.542
	EEE	textile	400	city	--	--	city	--	--	canal	none	0.002	0.002
	GGG	textile	1,250	city	--	--	city	--	--	canal	none	0.089	0.089
	HHH	chemical	80	well	none	*	well	pH adj.	*	well	none	*	0.094
	III	pulp & paper	400	well	soften	0.030	Savannah R.	complete soften	*	Savannah R.	complete soften	*	19.030
	JJJ	food-oils	85	city	--	--	well	soften & pH adj.	0.230	well	soften & pH adj.	0.057	0.237
SOUTH CAROLINA													
Abbeville	B	textile	565	well	none	*	well	soften	*	well	chlor.	*	0.281
	C	textile	510	Rocky R.	complete	0.010	Rocky R.	complete, soften	0.590	Rocky R.	complete	0.600	1.200
	D	dairy	4	well	none	*	well	none	*	--	--	--	0.001
	E	meat packing	21	well	none	*	well	none	*	--	--	--	0.001
	F	textile	750	city	--	--	well	soften	*	well	none	*	3.200
	H	textile	3,000	city & well	none	0.212	city & well	none	*	city & well	none	*	3.603
Anderson	N	textile	100	well	none	*	well	none	*	well	none	*	0.003
	O	meat packing	4	spring	none	*	spring	none	*	spring	none	*	0.002
	Q	textile	1,400	Baily Cr. & Beaver Dam Cr.	undet.	0.007	Baily Cr. & Beaver Dam Cr.	undet.	*	Baily Cr. & Beaver Dam Cr.	undet.	*	0.337
	R	dairy	23	well	none	*	well	none	*	--	--	--	0.008
	U	textile	543	spring	chlor.	0.009	spring	chlor.	0.135	--	--	--	0.144
	W	meat packing	18	well	none	*	well	none	*	well	none	*	0.010
	X	textile	800	well	none	*	well	none	*	well	none	*	0.280
	Y	textile	259	well	none	*	well	none	*	well	none	*	0.100
	Z	textile	750	23 Mile Cr.	undet.	0.100	23 Mile Cr.	undet.	*	23 Mile Cr.	undet.	*	1.200
	AA	textile	750	city	--	--	18 Mile Cr.	complete	*	18 Mile Cr.	undet.	*	1.500
	BB	textile	500	well	none	*	well	none	*	well	none	*	0.250
	DD	textile	240	well	none	0.005	well	none	0.037	--	--	--	0.042
	EE	meat packing	6	well	none	*	well	none	*	--	--	--	0.001
Oconee	HH	textile	402	Seneca R.	complete	*	Seneca R.	complete	*	Seneca R.	complete	*	0.250
	II	textile	2,500	Seneca R.	complete	0.005	Seneca R.	complete	*	Seneca R.	complete	*	3.000
	JJ	textile	300	well	none	*	well	none	*	--	--	--	0.001
	MM	meat packing	3	well	none	*	well	none	*	--	--	--	0.002
Pickens	PP	textile	280	well	none	*	well	none	*	well	none	*	0.100
	RR	textile	750	city & well	none	*	city & well	none	*	city & well	none	*	0.290
	SS	canning	40	well	none	*	well	none	*	--	--	--	0.025
	XX	meat packing	24	well	none	*	well	none	*	--	--	--	0.001
	AAA	textile	400	Town Cr.	complete	*	Town Cr.	complete	*	Town Cr.	complete	*	0.055
	BBB	metal prod.	1,300	city	--	--	well	none	*	well	none	*	0.030
		total	33,197										200.215

*Breakdown of water use not available; see last column for total water demand.
(5/1/62)

TABLE W-6
INDUSTRIAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* - 1975 AND 2000
SAVANNAH BASIN

Location by State and County	Code	Estimated 1975 Requirements mgd	Estimated 1975 Requirements Costs	Estimated 2000 Requirements mgd	Estimated 2000 Requirements Costs
GEORGIA					
Chatham	B	0.120	--	0.155	--
	C	6.000	--	6.000	--
	E	0.030	--	0.045	--
	F	2.620	--	1.890	--
	G	0.065	--	0.095	20,000
	H	0.020	--	0.030	--
	I	0.730	--	1.010	12,000
	J	2.220	--	3.080	50,000
	K	0.010	--	0.020	--
	L	0.160	--	0.220	12,000
	M	0.500	12,000	1.000	24,000
	N	0.200	--	0.265	12,000
	O	0.130	--	0.173	--
	P	21.400	9,000	29.300	20,000
	Q	12.000	12,000	17.500	44,000
	R	0.540	12,000	0.990	24,000
	S	117.700	--	117.700	--
	T	0.325	--	0.485	12,000
	V	0.040	--	0.060	--
	W	0.295	--	0.415	--
	Z	0.885	--	1.180	12,000
	AA	2.100	24,000	3.020	24,000
	New[1]	20.000	2,967,000	44.500	3,140,000
	New[2]	--	--	6.000	344,000
	New[3]	--	--	6.000	204,000
Elbert	CC	1.260	--	2.300	50,000
Hart	FF	2.800	12,000	4.000	24,000
	GG	1.460	3,000	4.240	10,000
	New[4]	7.000	1,610,000	16.800	1,340,000
Lincoln	HH	0.008	--	0.010	--
McDuffie	KK	0.025	--	0.020	--
	LL	0.012	--	0.010	--
Screven	NN	0.025	--	0.040	--
Stephens	PP	0.282	--	0.810	--
	QQ	0.148	--	0.435	--
Richmond	SS	0.075	--	0.100	--
	TT	0.230	--	0.405	75,000
	UU	0.116	--	0.100	--

(5/1/62)

TABLE W-6 (CONT'D)
INDUSTRIAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* - 1975 AND 2000
SAVANNAH BASIN

Location by State and County	Code	Estimated 1975 Requirements		Estimated 2000 Requirements	
		mgd	Costs	mgd	Costs
GEORGIA (Cont'd)					
Richmond	VV	0.040	--	0.055	--
	WW	0.890	--	1.285	--
	YY	0.500	--	0.500	--
	CCC	0.120	--	0.185	--
	DDD	1.000	12,000	1.350	12,000
	EEE	0.002	--	0.002	--
	GGG	0.085	--	0.075	--
	HHH	0.120	--	0.165	12,000
	III	19.030	--	19.030	--
	JJJ	0.423	65,000	0.625	85,000
SOUTH CAROLINA					
Abbeville	B	0.275	--	0.230	--
	C	1.180	--	1.000	--
Aiken	D	0.002	--	0.002	--
	E	0.001	--	0.002	--
	F	3.100	--	2.600	--
	H	3.500	--	2.960	--
Anderson	N	0.003	--	0.002	--
	O	0.003	--	0.005	--
	Q	0.330	--	0.280	--
	R	0.010	--	0.015	--
	U	0.140	--	0.120	--
	W	0.015	--	0.020	--
	X	0.270	--	0.230	--
	Y	0.100	--	0.080	--
	Z	1.170	--	0.980	--
	AA	1.460	--	1.230	--
	BB	0.245	--	0.205	--
	DD	0.040	--	0.035	--
	EE	0.001	--	0.002	--
Oconee	HH	0.240	--	0.205	--
	II	2.880	--	2.460	--
	JJ	0.001	--	0.001	--
	MM	0.003	--	0.005	--
Pickens	PP	0.100	--	0.080	--
	RR	0.280	--	0.240	--
	SS	0.035	--	0.050	--

TABLE W-6 (CONT'D)
INDUSTRIAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* - 1975 AND 2000
SAVANNAH BASIN

Location by State and County	Code	Estimated 1975 Requirements		Estimated 2000 Requirements	
		mgd	Costs	mgd	Costs
SOUTH CAROLINA (Cont'd)					
Pickens	XX	0.001	--	0.002	--
	AAA	0.055	--	0.045	--
	BBB	0.055	--	0.130	12,000
Totals		240.236	$4,738,000	306.891	$5,564,000

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* Based on January 1960 constant dollars.

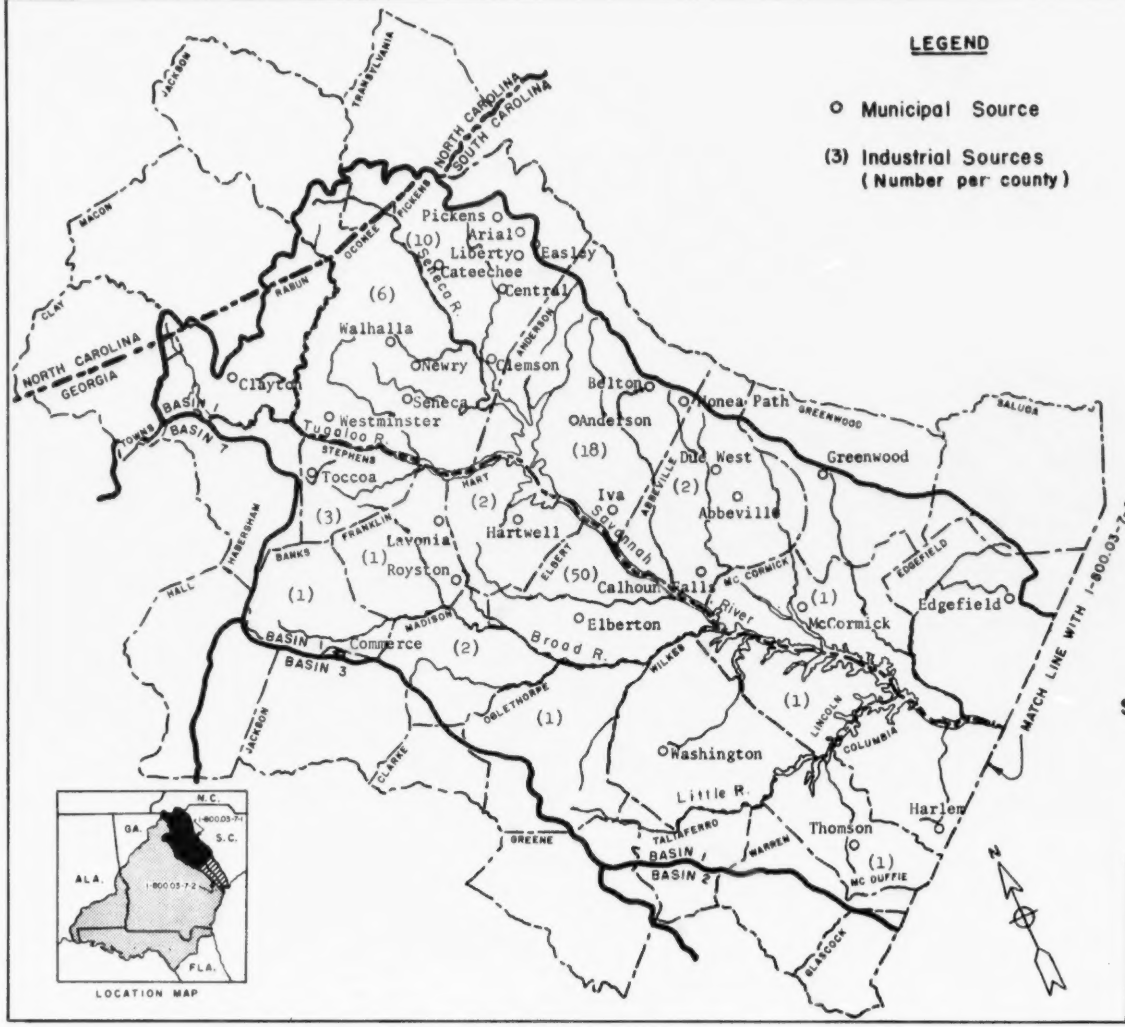
1 -pulp and paper
2 -chemical
3 -glass products
4 -pulp and paper

(5/1/62)

P-1

POLLUTION ABATEMENT

P-1-a


LEGEND
○ Municipal Source
(3) Industrial Sources (Number per county)
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
JACKSON
TRANSYLVANIA
MACON
CLAY
RABUN
OCONEE
PICKENS
TOWNS
HABERSHAM
HALL
BANKS
STEPHENS
FRANKLIN
HART
ANDERSON
ABBEVILLE
ELBERT
MADISON
OGLETHORPE
CLARKE
JACKSON
GREENE
WILKES
TALIAFERRO
WARREN
LINCOLN
COLUMBIA
MC DUFFIE
GLASCOCK
MC CORMICK
GREENWOOD
EDGEFIELD
SALUDA
Pickens
Arial
Liberty
Easley
Cateechee
Central
Seneca R.
(10)
(6)
Walhalla
Newry
Clemson
Seneca
Clayton
Westminster
Tugaloo R.
Toccoa
(3)
Belton
Honea Path
Anderson
(18)
Due West
(2)
Abbeville
Greenwood
Iva
Savannah
(2)
Hartwell
Lavonia
(1)
Royston
(50)
Calhoun Falls
River
(1)
McCormick
Edgefield
Elberton
(1)
Commerce
(2)
Broad R.
(1)
(1)
Washington
Little R.
Thomson
(1)
Harlem
BASIN 1
BASIN 7
BASIN 1
BASIN 3
BASIN 1
BASIN 2
MATCH LINE WITH 1-800.03-7-2
N
N.C.
GA.
S.C.
ALA.
FLA.
1-800.03-7-1
1-800.03-7-2
LOCATION MAP

SOURCES OF POLLUTION

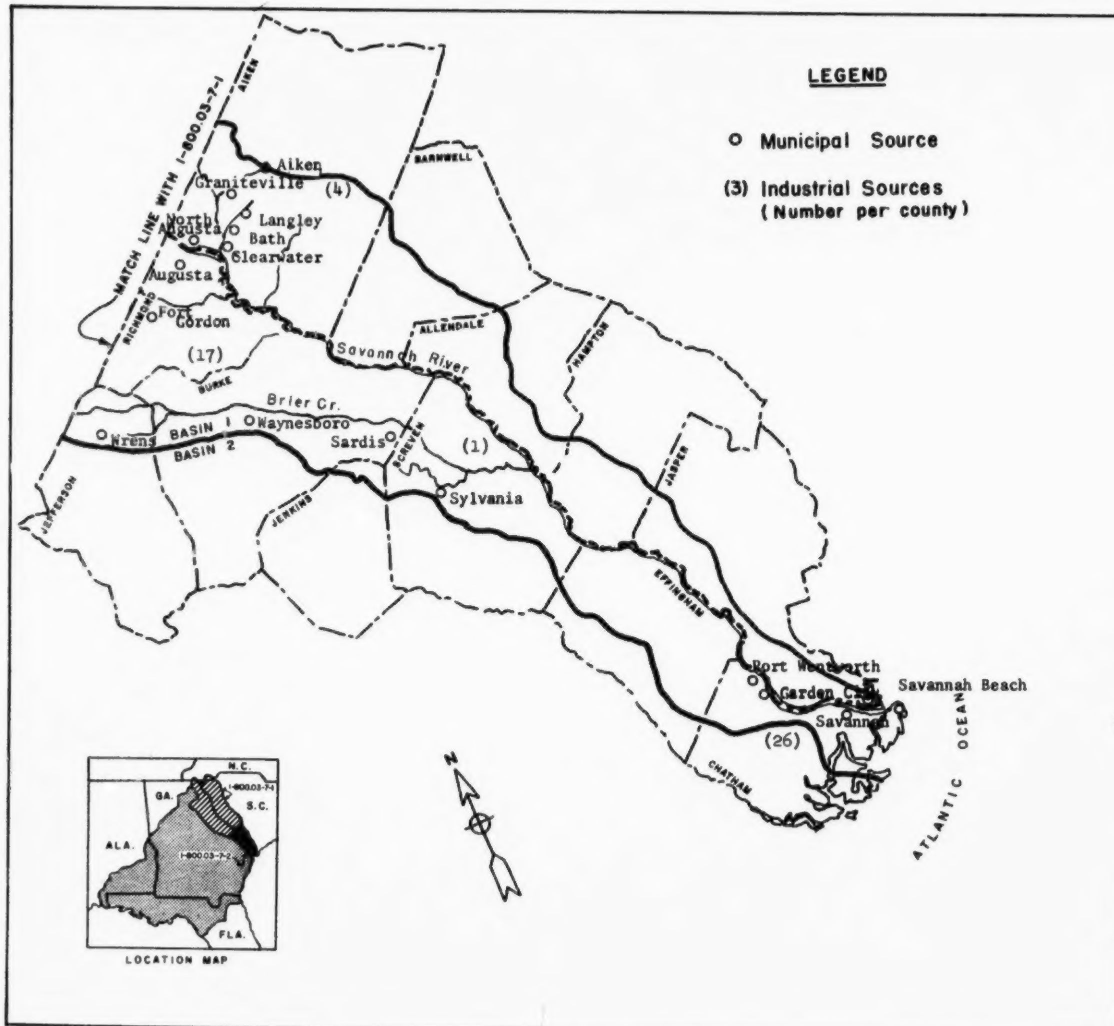
FIGURE P-1

0 10 20 30 Miles

PUBLIC HEALTH SERVICE
REGION IV

SAVANNAH
BASIN NO. 1

JANUARY 1, 1960


LEGEND
○ Municipal Source
(3) Industrial Sources (Number per county)
MATCH LINE WITH 1-800.03-7-1
AIKEN
BARNWELL
ALLENDALE
HAMPTON
JASPER
EFFINGHAM
CHATHAM
RICHMOND
BURKE
SCREVEN
JENKINS
JEFFERSON
Aiken
Graniteville
(4)
North Augusta
Langley
Bath
Clearwater
Augusta
Fort Gordon
(17)
Savannah River
Brier Cr.
Wrens
BASIN 1
BASIN 2
Waynesboro
Sardis
(1)
Sylvania
Port Wentworth
Garden City
Savannah
Savannah Beach
(26)
ATLANTIC OCEAN
N
N.C.
S.C.
GA.
ALA.
FLA.
1-800.03-7-1
1-800.03-7-2
LOCATION MAP

SOURCES OF POLLUTION

FIGURE P-1

0 10 20 30 Miles

PUBLIC HEALTH SERVICE
REGION IV

SAVANNAH
BASIN NO. 1

JANUARY 1, 1960

P-1-b

INTRODUCTION

SCOPE OF MEMORANDUM

This memorandum contains data and information concerning the present status of municipal and industrial sewage works in the Savannah Basin. The City of Savannah, which discharges most of its sewage and all of the industrial liquid wastes to the Savannah Basin, has been included in this memorandum. However, the portion of the sewage which is discharged to the Ogeechee Basin has been excluded. The communities of Belton, Easley, Greenwood, and Honea Path, South Carolina discharge a portion of their sewage outside the SERB area. Only those portions of these communities' wastes which are discharged to the Savannah Basin have been considered in this memorandum. Baldwin, Georgia which lies within the Savannah Basin is expected to discharge its wastes to the Chattahoochee Sub-basin and therefore has not been considered in this memorandum.

Information regarding the operation of the Atomic Energy Commission Savannah River plant located in Aiken County, South Carolina is not available. Therefore, data on waste disposal by this plant has not been included in this memorandum.

Projected future pollution abatement requirements for industries and municipalities by the years 1975 and 2000 are presented, as are suggested solutions to present and anticipated future inadequacies. In connection with these solutions, an appraisal of the benefits to be derived from the proposed program and the annual costs of pollution abatement are included.

PROCEDURES AND INVESTIGATIONS

Existing data on pollution abatement in the Basin were obtained from reports, records, and correspondence of the South Carolina Department of Public Health, the South Carolina Water Pollution Control Authority, the South Carolina State Chamber of Commerce, the Georgia Department of Public Health, the Georgia State Chamber of Commerce, the Georgia Department of Commerce, and other State and Federal agencies. Where data were found to be lacking or outdated, extensive field investigations were conducted. Field investigations were conducted in the Georgia portion of the Basin during January and February, 1961 by the Georgia Department of Public Health and data were submitted to the Public Health Service for inclusion in this memorandum. The field investigations of the Georgia Department of Public Health included visits to municipalities, small communities, industries, and institutions. Existing data for the South Carolina portion of the Basin which were made available by the South Carolina Water Pollution Control Authority and the South Carolina Department of Public Health were sufficient for inclusion in this memorandum.

Data were obtained regarding 62 municipal (which includes 11 institutions) and 99 industrially owned sewage and waste works in the Basin (Figure P-1). The data were carefully studied to establish both the present and future pollution abatement requirements.

BASIC ASSUMPTIONS

Populations of individual municipalities have been projected to 1975 and 2000 using census data where available or estimated populations for communities not listed in the census reports. Projections were made by applying the geometric progression method based on the rate of increase over the period 1930-1960 modified by considerations of changing economic conditions. However, the population projections of urban areas (municipalities of 2500 or more) were adjusted to match projections made by the U. S. Study Commission - SERB.

Existing industries are expected to increase or decrease their waste discharge in the future in proportion to the projected industrial increase or decline. In addition, several new industries are expected to locate in the Basin. For the purpose of this memorandum, it is assumed that municipalities of 800 or more should be sewered now and municipalities of less than 800 should be sewered whenever the present methods of disposal are considered inadequate. It is also assumed that each municipality, regardless of population, now partially sewered, should extend its collection system to serve the total population.

In the administration of "Grants for Construction" under Section 6 of Public Law 660 and its amendments, the Public Health Service has established "the substantial removal of settleable solids" as the minimum acceptable treatment for projects in which the Federal Government participates. In general, the Public Health Service considers primary treatment to be the minimum acceptable degree of treatment for municipal sewage and an equivalent treatment the minimum for industrial liquid wastes. The need for additional treatment has been determined on the basis of expected dilution water available during periods of low stream flow and/or downstream water use. Stabilization ponds have been recommended for most municipalities with less than 1500 persons.

It is assumed that primary treatment plants will effect 35 percent BOD removal and secondary plants will effect 85 percent BOD removal. Tertiary treatment or a greater than 85 percent BOD removal has not been considered for purposes of reducing low flow requirements. At these higher treatment efficiencies, dilution water requirements for water quality control depend on dilution of nutrients and chemicals present in the water rather than dilution of remaining BOD. Plant nutrients and chemicals are reduced very little if any, in conventional sewage treatment plants and must therefore, be considered as important pollutants in sewage effluents.

Sewage works costs have been estimated on the basis of per capita cost data developed by the Public Health Service and adjusted on the basis of the January 1, 1960 Engineering News Record Construction Cost Index for Atlanta, Georgia. Engineering, legal, and financing costs have been added on the basis of United States experience for the period July 1956-June 1959. Sewage system costs include the cost of structures, devices, equipment, and appurtenances intended for the collection and pumping of sewage. Treatment plant costs include the cost of treatment facilities and outfall lines.

Annual equivalent capital costs, annual operation and maintenance costs, and replacement costs of existing and needed pollution abatement facilities were estimated on the basis of January 1, 1960 constant dollars. An interest rate of 4½ percent was used for determining annual costs for both industries and municipalities.

GENERAL

Water pollution may be defined as the adding to water of any substance, or the changing of water's characteristics in any way which interferes with its use for legitimate purposes. Water polluting substances may be classified according to eight general categories: (1) Sewage and other oxygen demanding wastes, (2) infectious agents, (3) plant nutrients, (4) organic chemical exotics, (5) sediments, (6) radioactive substances, (7) heat, and (8) toxic and other mineral and chemical substances.

The Nation and its communities, as well as business and private operations and individuals, incur losses or damages because of water pollution. Some of these losses or damages are reflected directly in additional costs for construction, operation and maintenance of water treatment facilities. By far the larger share of the total damages is not directly accountable. The impairment to health, the loss or diminution of fishing and recreational uses, and depreciated property values, caused by polluted waters, have an adverse economic impact which is diffused throughout society. This is paid for through the reduction in utility of the water resources and the restriction on economic growth rather than through dollar payments for corrective devices. Unfortunately, these indirect consequences of pollution are not readily expressed in dollar terms because of their diffusiveness and because they are not recorded by direct, open-market transactions. Nevertheless, such adverse consequences are real and constitute a handicap to the fulfillment of economic and social goals.

Pollution control measures alleviate these adverse conditions and produce economic benefits associated with the improved waters. These benefits are often not apparent to the public, however, because they constitute insurance for future usefulness as well as for immediate purposes, or they may be indirect or intangible. The computation of these benefits faces the same difficulties as the computation of the total damages. That is, the dollar measurement problem has not yet been solved and a yardstick for actions or events not recorded in market transactions is lacking. Many of the benefits from pollution control are in this nonmarket realm, e.g., enhancement of fishing and recreational opportunity, protection of health, scenic improvement, and assurance of the future utility of water resources for various other purposes. The private market price system, therefore, cannot be relied upon solely or chiefly to provide the measurement. New devices for taking into account the social or public values must be devised.

INVENTORY OF POLLUTION ABATEMENT

SOURCES OF POLLUTION

The surface waters of the Basin are used for the final disposal of liquid wastes, treated and untreated, from 62 municipalities (including 11 institutions), and 99 industries as shown in Tables P-1 and P-2. Municipalities and institutions discharge 37.6 mgd of sewage of which 12.43 mgd has undergone treatment of some type and industries discharge 138.52 mgd of which 58.9 mgd has undergone treatment of some type.

The 62 municipalities and institutions, which include Fort Gordon Army Base and a portion of the City of Savannah, collect sewage from 404,980 people. The total population equivalent (PE) of the municipal sewage discharged to the Savannah Basin is estimated to be 536,610 before treatment and 440,180 after treatment.

The industrial wastes produced in the Basin are varied and include food, lumber, pulp and paper, chemical, metal, and textile wastes. The strength of the organic wastes from the 80 industries for which data were available is estimated to be 1,931,000 PE based on BOD. There are 24 other industries which produce inorganic liquid wastes such as acids, alkalies, sediments, etc. The population equivalent of the industrial wastes after treatment is estimated to be 1,740,000.

The waters of the Basin also receive pollution from natural sources and from the agricultural use of the land. Pollution from natural sources includes organic material leached from the decaying matter in forests and swamps and minerals dissolved from the soil and rocks. The pollution resulting from the agricultural use of the land includes organic and mineral fertilizers, insecticides, pesticides, and herbicides which are washed into the waters during heavy rains or which are inadvertently deposited into the waters during application. Silt eroded from roadsides and farm land, especially in the Piedmont Province, is a pollutant in the upper half of the Basin. Drainage from livestock feed lots, dairy barns, pig pens, manure heaps, and other farm refuse also adds to the pollution load carried by the streams.

EXISTING SEWAGE TREATMENT FACILITIES

As shown in Table P-1, 15 municipalities and institutions provide secondary treatment for sewage collected from 68,324 persons (or 16.9 percent of the total sewered population discharging sewage to the Basin's waters). Stabilization ponds have been considered as secondary treatment plants for the purpose of this summary.

There are 4 municipalities and institutions in the Basin which provide primary treatment for the sewage collected from 59,715 persons, (or 14.8 percent of the total sewered population discharging sewage to the Basin's waters). Five municipalities, Iva, Liberty, Pickens, Walhalla, and Westminister, South Carolina provide primary treatment for only a portion (6,600 persons) of their sewered population. The remaining portion (1,800 persons) of their sewered population is served by septic tanks except in one municipality which provides no treatment for the remaining portion of its population.

Septic tanks are provided by five municipalities and five institutions, and serve a population of 7,700 persons. The septic tanks provided at the Augusta Airport, Lavonia, and Royston, Georgia and Arial, Gluck Mill Village, Iva, and Liberty, South Carolina are overloaded and consequently ineffective as treatment facilities.

The remaining 18 municipalities and institutions provide no sewage treatment facilities. Although the Alto Industrial Institute has a secondary treatment plant, it is reported to be inoperative and this institution has been considered to have no treatment. Sewage collected from 260,844 persons (or 64.5 percent of the total sewered population discharging sewage to the Basin's waters) in these municipalities is discharged untreated to the surface waters of the Basin. The Graniteville, South Carolina sewage treatment plant also serves the communities of Warrenton and Vaucluse, South Carolina and their populations have been included in the Graniteville figures. Although Bath, South Carolina is reported as having no treatment, comminution and chlorination of the sewage is provided before discharge.

As shown in Table P-2, 43 of the 99 industries listed provide treatment of some degree for their liquid wastes. Four of these however, provide no reduction of the BOD load discharged from the plants. The remaining 56 industries provide no treatment for their liquid wastes.

Two of the industrial plants discharge their wastes to the land and 54 discharge untreated wastes directly to the surface waters of the Basin. The industries which are listed as providing catch basins have been considered to have no treatment.

Ten industries provide the equivalent of secondary treatment and 18 provide the equivalent of primary treatment for their industrial liquid wastes. The remaining 71 industries provide either septic tanks, screens, catch basins or no treatment at all for their wastes.

All other industries which are not shown by Table P-2 discharge liquid wastes either to septic tanks with sub-surface drain fields or to municipal sewer systems. Industries disposing of liquid wastes by these methods were not inventoried and no data are available.

Soil conservation practices used in many areas of the Basin are very useful in preventing pollution resulting from agricultural use of the land. Good erosion preventive measures, practiced by the highway and railroad maintenance departments, assist in the control of sediment coming from roadway embankments. There are no pollution control measures used especially for the purpose of abating pollution ftom natural sources.

EFFECTS ON STREAMS

According to field studies conducted by the Public Health Service, the waters of the main stem of the Savannah River above the Clark Hill Dam are relatively free from pollution. However, localized pollution conditions existed in several tributary streams in the upper portion of the Basin which receive municipal waste discharges. Bacterial contamination from the municipal discharges is the major pollutant in these tributary streams.

The waters of the main stem of the Savannah River in the reach from Clark Hill Dam to the estuary are of good quality except for municipal sewage pollution below Augusta, Georgia and for municipal andindustrial pollution for Savannah, Georgia. The Savannah River water is generally soft and low in mineral content throughout the year except for the estuary section of the river which is mixed with sea water. Wastes containing radioactive substances are discharged to the river by the U. S. Atomic Energy Commission Plant located approximately 25 miles downstream from Augusta, Georgia. Continuous sampling of the river by the U. S. Atomic Energy Commission and stream surveys conducted by the Public Health Service show that no radioactivity hazard exists in the river although occasional breakdowns in waste handling procedures have resulted in some high radioactivity counts in the river.

The lower reach of the Savannah River below Port Wentworth, Georgia is heavily polluted due to untreated municipal and industrial wastes which are discharged to the river from the Savannah area. The river downstream from Savannah is sometimes entirely depleted of its dissolved oxygen content, which results in an "oxygen block" to fish during the summer months. Extensive mobile sludge banks up to 12

TABLE P 1
BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Estimated Average Flow mgd	Type of Treatment	Design Capacity PE 1,000s	Design Capacity Flow mgd	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Receiving Stream
GEORGIA									
Alto									
Indust. Inst.	650	650	0.065	None	--	--	800	800	Trib-Hudson R-Broad R
Augusta	70,626	85,000	8.500	None	--	--	127,500	127,500	Tribs and Savannah R
Airport	75	75	0.003	Septic tank	undet	undet	75	75	Butler Cr-Savannah R
Boggs Academy	200	200	0.010	Stabilization pond	0.40	undet	200	80	Trib-Little Cr-Briar Cr
Clayton	1,507	1,200	0.090	Primary	0.80	0.01	1,500	1,000	Stekoa Cr-Chattooga R-Tugaloo R
Commerce	3,551	3,500	0.650	Primary	5.00	0.50	11,500	9,800	Grove Cr-Hudson R-Broad R
Elberton #1	7,107	3,500	0.350	None	--	--	3,500	3,500	Trib-Beaver Dam Cr-Savannah R
#2		3,500	0.350	None	--	--	3,500	3,500	Trib-Falling Cr-Broad R
Fort Gordon Army Base	12,000	12,000	1.446	Secondary	40.0	4.00	12,365	1,236	Spirit Cr-Savannah R
Franklin Springs College	160	160	0.007	Septic tank	undet	undet	160	145	Branch-Broad R
Garden City	5,451	4,750	0.200	None	--	--	4,750	4,750	Savannah R
Chatham City		1,800	0.070	Primary	undet	undet	1,800	1,000	Trib-Dundee Canal-Savannah R
Gracewood School for Mental Defective	1,942	1,942	0.153	Secondary	1.20	undet	2,200	1,500	Spirit Cr-Savannah R
Gracewood School for Boys	212	212	0.010	Secondary	undet	undet	212	170	Butler Cr-Savannah R
Harlem	1,423	1,350	0.120	Primary	1.00	--	1,350	1,000	Trib-Uchee Cr-Savannah R
Hartwell #1	4,599	760	0.100	None	--	--	760	760	Trib-Lightwood Log Cr-Hartwell Reservoir
#2		3,000	0.300	None	--	--	3,800	3,800	Trib-Cedar Cr-Savannah R
Lavonia #1	2,088	1,500	0.120	Septic tanks	undet	undet	1,500	1,500	Br-Shoal Cr-Hartwell Res.
#2		500	0.040	Septic tank	undet	undet	500	500	Unawattie Cr-Broad R
Port Wentworth #1	3,705	1,500	0.080	None	--	--	1,500	1,500	Savannah R

(11/1/61)

TABLE P-1 (CONT'D)
BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Estimated Average Flow mgd	Type of Treatment	Design Capacity		Estimated PE (BOD)		Receiving Stream
					PE 1,000s	Flow mgd	Untr'd Waste	Disch'd Waste	
GEORGIA (Cont'd)									
Port Wentworth #2		1,500	0.080	None	--	--	1,500	1,500	Ditch to Savannah R
(Sawmill Village)		225	0.015	None	--	--	225	225	Savannah R
Richmond County	--	15,000	1.500	None	--	--	18,750	18,750	Rocky Cr-Savannah R
Royston #1	2,333	1,000	0.040	Septic tank	undet	undet	1,000	1,000	Trib-Broad River-Savannah R
#2		1,000	0.040	Septic tank	undet	undet	1,000	1,000	S. Beaver dam Cr-Savannah R
Sardis	829	829	0.080	None	--	--	829	829	Chandlres Mill Br-Briar Cr
Savannah (part)		105,000	10.500	None	--	--	155,000	155,000	Savannah R
Travis Field	1,500	1,500	0.100	Primary	10.00	undet	1,500	700	Pipe Makers Canal-Savannah
Savannah Beach	1,385	3,000	0.140	Primary	5.00	0.50	3,000	1,950	Savannah R
Hotel	350	350	0.020	Septic tank	undet	undet	350	300	Turners Cr-Wilmington R
Sylvania	3,469	3,000	0.180	Secondary	5.00	0.50	3,000	450	Buck Cr-Savannah R
Thomson	4,522	3,825	0.360	Primary	5.00	1.00	3,900	2,225	White Cr-Big Briar Cr-Savannah R
Toccoa #1	7,303	4,800	0.360	None	--	--	5,700	5,700	Eastanollee Cr-Hartwell Reservoir
#2		1,200	0.100	None	--	--	1,200	1,200	Toccoa Cr-Hartwell Res.
Toccoa Falls Institute	400	400	Undet	Septic tank	undet	undet	400	360	Toccoa Cr-Hartwell Res.
Washington	4,440	2,800	0.300	Secondary	10.00	1.00	3,500	2,000	Rocky Cr-Little R-Savannah R
Waynesboro	5,359	4,400	1.000	Secondary	8.00	0.80	4,500	450	McIntosh Cr-Big Briar Cr-Savannah R
Prison	152	75	Undet	Septic tank	undet	undet	75	60	Trib-McIntosh Cr-Briar Cr.
Wrens	1,628	800	0.225	Primary	2.25	undet	800	400	Brushy Cr-Big Briar Cr-Savannah R
SOUTH CAROLINA									
Abbeville	5,436	6,000	0.600	Secondary	8.00	1.00	6,000	900	Parkens Cr-Little River-Savannah R
Aiken	11,243	18,000	1.500	Secondary	15.00	1.00	22,500	1,800	Wilkerson Cr-Horse Cr-Savannah R

(5/1/62)

TABLE P-1 (CONT'D)
BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION
SAVANNAH BASIN

Municipality	1960 Population	Estimated Population Served	Estimated Average Flow mgd	Type of Treatment	Design Capacity PE 1,000s	Design Capacity Flow mgd	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Receiving Stream
SOUTH CAROLINA (Cont'd)									
Anderson	41,316	20,160	0.442	Primary	10.00	1.00	26,000	13,000	Big Generostee Cr-Savannah
		15,600	0.220	Primary	15.00	1.50	17,000	11,900	Rocky R-Savannah R
Arial	1,098	1,000	0.100	Septic tank	undet	undet	1,000	1,000	Rice Cr-12 Mile Cr-Hartwell Reservoir
Bath	1,419	1,000	0.100	None	--	--	1,000	1,000	Horse Cr
Belton #2	5,106	1,500	0.020	Secondary	undet	undet	1,700	1,250	Hencoop Cr-Rocky R
#3		1,500	0.120	Secondary	undet	undet	2,500	2,000	Cupboard Cr-Rocky R
Calhoun Falls	2,525	2,900	0.290	Secondary	undet	undet	2,900	1,500	Swaney Cr-McKinney Cr-Savannah R
Cateechee	600	600	0.060	Primary	undet	undet	600	470	12 Mile Cr-Hartwell Res.
Central #1	1,473	780	0.080	Primary	undet	undet	780	280	5 Mile Cr-18 Mile Cr-Hartwell Res.
#2		400	0.035	Primary	undet	undet	400	280	12 Mile Cr-Hartwell Res.
#3		600	0.060	Primary	undet	undet	600	480	18 Mile Cr-Hartwell Res.
Clearwater	1,450	1,200	0.120	None	--	--	1,200	1,200	Little Horse Cr-Horse Cr-Savannah R
Seminole Mills Village	500	500	0.050	None	--	--	500	500	Branch-Horse Cr-Savannah R
Clemson	1,587	700	0.070	Septic tank	undet	undet	700	560	Hartwell Reservoir
Clemson College	4,000	4,000	0.400	None	--	--	4,000	4,000	Hartwell Reservoir
Due West	1,166	1,000	0.100	Secondary	2.50	undet	1,000	150	Chickasaw Cr-Little R
Easley (part)	8,283	1,860	0.150	Stabilization pond	1.86	0.15	1,860	280	18 Mile Cr
Edgefield	2,876	1,800	0.180	Primary	undet	5.00	2,500	800	Beaverdam Cr-Stephens Cr
Gluck Mill Village	250	250	0.025	Septic tank	undet	undet	250	250	Beaverdam Cr-Rocky Cr
Graniteville	2,585	5,000	0.500	Secondary	10.00	1.00	5,000	500	Wise Cr-Horse Cr-Savannah R
Greenwood (part)	16,644	6,000	1.200	Secondary	15.00	1.50	12,000	1,200	Hard Labor Cr-Stephens Cr
Honea Path (part)	3,453	1,200	0.120	Primary	undet	undet	1,200	960	Corner Cr-Little R
Iva #1	1,357	650	0.065	Primary	undet	undet	650	420	Canoe Cr-Generostee Cr-Savannah R

(11/1/61)

TABLE P-1 (CONT'D)
BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION
SAVANNAH BASIN

Municipality		1960 Population	Estimated Population Served	Estimated Average Flow mgd	Type of Treatment	Design Capacity		Estimated PE (BOD)		Receiving Stream
						PE 1,000s	Flow mgd	Untr'd Waste	Disch'd Waste	
SOUTH CAROLINA (Cont'd)										
Iva	#2		400	0.040	Septic tank	undet	undet	400	400	East Beards Cr-Rocky R
	#3		300	0.030	Septic tank	undet	undet	300	290	Canoe Cr-Generostee Cr
Langley		1,216	1,500	0.150	None	--	--	1,500	1,500	Horse Cr-Savannah R
Liberty	#1	2,657	1,000	0.100	Primary	undet	undet	1,000	800	Branch-Golden Cr-Hartwell Res.
	#2		350	0.035	Septic tank	undet	undet	350	320	15 Mile Cr-Hartwell Res.
	#3		350	0.035	Septic tank	undet	undet	350	320	18 Mile Cr-Hartwell Res.
	#4		300	0.030	Septic tank	undet	undet	300	170	Branch-Hartwell Res.
McCormick		1,998	1,600	0.160	Primary	undet	undet	1,600	1,300	Rocky Cr-Stephens Cr
Newry		762	1,200	0.120	None	--	--	1,970	1,970	Little R-Hartwell Res.
North Augusta		10,348	13,000	1.300	None	--	--	16,300	16,300	Savannah R
Pickens	#1	2,198	1,400	0.125	Primary	undet	undet	1,400	1,100	Wolf Cr-Hartwell Res.
	#2		300	0.030	Septic tank	undet	undet	300	240	Town Cr-Hartwell Res.
	#3		100	0.010	Septic tank	undet	undet	100	80	Wolf Cr-Hartwell Res.
Seneca	#1	5,227	700	0.070	None	--	--	700	700	Coneross Cr-Hartwell Res.
	#2		4,000	0.350	None	--	--	4,000	4,000	Martin Cr-Hartwell Res.
Walhalla	#1	3,431	2,530	0.250	None	--	--	2,500	2,500	Cane Cr-Little R-Hartwell Res.
	#2		950	0.095	Primary	undet	undet	1,000	850	Coneross Cr-Hartwell Res.
Westminister	#1	2,413	600	0.060	Primary	1.00	0.10	600	540	England Cr-Choestoea Cr-Hartwell Res.
	#2		1,800	0.180	Primary	1.50	0.15	1,800	1,440	Norris Cr-Coneross Cr-Hartwell Res.
	#3		200	0.020	Primary	1.25	0.13	200	160	Moss Cr-Hartwell Res.
	#4		200	0.020	Septic tank	1.25	0.13	200	180	Miller Br-Hartwell Res.
	#5		200	0.020	Septic tank	0.75	0.08	200	180	Sheldon Cr-Hartwell Res.
Totals			404,980	37.600				536,610	440,180	

(5/1/62)

TABLE P-2

BASIC DATA ON SOURCES OF INDUSTRIAL POLLUTION

(Excludes industries connected to municipal sewer systems)

SAVANNAH BASIN

Location by State and County	Code	Number of Employees	Type of Industry	Type of Waste	Estimated Average Flow mgd	Treatment Provided	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Discharged To
GEORGIA									
Banks	A	10	food	meat pk	0.002	none	2,040	none	land
Chatham	B	100	lumber	creosote-oil	undet	settling	undet	undet	ditch to Savannah R
				sanitary	0.005	septic tank	100	80	Savannah R
	C	575	pulp & paper	process	19.000	none	90,000	90,000	Savannah R
				sanitary	0.029	none	60	60	Savannah R.
	D	90	asphalt roofing	cooling water	0.095	none	--	--	canal
	E	15	food	meat pk	0.017	none	1,100	1,100	Ogeechee canal-Savannah R
	F	180	chemical	naval stores	2.690	oil traps	undet	undet	Savannah R
	G	263	food	bakery	0.024	pond	undet	none	pond with no outlet
	H	28	chemical	bleach-starch	0.004	settling	undet	undet	pond
	I	225	felt & roofing	process	0.500	none	15,200	15,200	Savannah R
				sanitary	0.020	none	225	225	Savannah R
	J	99	refinery	petroleum	1.600	separator	--	--	Savannah R
				sanitary	0.005	none	25	25	Savannah R
	K	300	metal	metal fabr.	0.004	none	--	--	Savannah R
				sanitary	0.015	septic tank	75	60	Savannah R
	L	30	food	meat pk	0.105	catch basin	2,640	2,640	canal to Savannah R
	M	40	chemical	acids	0.650	none	--	--	Savannah R
				sanitary	0.002	none	40	40	Savannah R
	N	50	chemical	fertilizer	0.015	none	--	--	Savannah R
				cooling water	0.140	none	--	--	Savannah R
	O	50	chemical	NaF	0.001	neutralized	--	--	Savannah R
				cooling water	0.100	none	--	--	Savannah R
				sanitary	0.002	none	50	50	Savannah R
	P	330	chemical	acids	25.000	lagoon	--	--	Savannah R
				sanitary	0.017	lagoon	--	--	Savannah R
	Q	500	food	sugar ref.	2.500	none	150,000	150,000	Savannah R
	R	287	gyp. board	sanitary	0.014	none	280	280	Savannah R
			process	process	undet	none	--	--	Savannah R

TABLE P-2 (CONT'D)
BASIC DATA ON SOURCES OF INDUSTRIAL POLLUTION
(Excludes industries connected to municipal sewer systems)
SAVANNAH BASIN

Location by State and County	Code	Number of Employees	Type of Industry	Type of Waste	Estimated Average Flow mgd	Treatment Provided	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Discharged To
GEORGIA - cont'd									
Chatham	S	5,100	pulp & paper	kraft proc.	40.000	none	1,110,000	1,110,000	Savannah R
				sanitary	0.250	none	510	510	Savannah R
	T	100	food	meat pk	0.214	catch basin	6,000	6,000	Ogeechee canal-Savannah R
				sanitary	0.005	catch basin	25	25	Ogeechee canal-Savannah R
	U	20	chemical	naval stores	undet	none	undet	undet	Ogeechee canal-Savannah R
				sanitary	0.001	catch basin	20	15	Ogeechee canal-Savannah R
	V	32	food	meat pk	0.025	none	250	250	Dundee canal-Savannah R
				sanitary	0.002	septic tank	30	20	Dundee canal-Savannah R
	W	160	felt & roofing	pulp & paper	0.045	none	5,000	5,000	Savannah R
				cooling water	0.029	none	undet	undet	Savannah R
				sanitary	0.008	settling	160	100	Savannah R
	Y	240	chemical	organics	1.600	none	undet	undet	swamp
	Z	61	chemical	acid	0.400	none	--	--	Casey canal
				phosphate	0.300	none	--	--	Casey canal
				sanitary	0.003	septic tank	60	50	Casey canal
	AA	250	food	veg. oil	0.525	skimming	undet	undet	Savannah R
				cooling water	0.787	none	undet	undet	Savannah R
	BB	24	metal	oil & solv.	0.005	none	undet	undet	ditch-Savannah R
Elbert	CC	1,250	stone	granite dust	0.500	none	--	--	various streams*(50 plants)
	DD	325	textile	sizing	0.190	none	1,500	1,500	Beaver Dam Cr-Savannah R
				sanitary	0.017	septic tank	325	260	Beaver Dam Cr-Savannah R
Franklin	EE	110	textile	dye & rinse	0.040	none	750	750	Pooles Cr-Broad R
Hart	FF	18	mining	mica & clays	1.440	settling	--	--	Cedar Cr-Savannah R
	GG	574	metal	metal prod.	0.100	pond	--	--	Lightwood Log Cr-Hartwell Reservoir
Lincoln	HH	15	food	poultry proc.	0.004	septic tank	170	none	woodland area
Madison	II	158	textile	sanitary	0.007	septic tank	45	40	trib-South Fork-Broad R
	JJ	10	food	meat pk	0.003	septic tank	50	45	trib-South Fork-Broad R

TABLE P-2 (CONT'D)
BASIC DATA ON SOURCES OF INDUSTRIAL POLLUTION
(Excludes industries connected to municipal sewer systems)
SAVANNAH BASIN

Location by State and County	Code	Number of Employees	Type of Industry	Type of Waste	Estimated Average Flow mgd	Treatment Provided	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Discharged To
GEORGIA - cont'd									
McDuffie	LL	650	textile	sanitary	0.007	primary	114	75	Sills Cr-Little R-Savannah
Oglethorpe	MM	123	textile	proc.& sant.	0.050	septic tank	936	840	Grove Cr-Broad R
Screven	NN	4	food	meat pk	0.006	primary	120	75	branch-Buck Cr-Savannah R
Stephens	OO	597	textile	proc.& sant.	1.920	settling	10,150	7,650	Eastanolle Cr-Hartwell Res
	PP	1,000	metal	metal prod.	0.140	settling	--	--	pond
	QQ	38	metal	metal prod.	0.085	none	--	--	Walton Cr-Tugaloo R
Richmond	RR	2	food	meat pk	0.001	septic tank	40	30	Creek-Savannah R
	SS	65	chemical	dye & finishes	0.004	none	undet	undet	marsh-Savannah R
	TT	80	lumber	wood treat.	0.208	skimming	undet	undet	Rocky Cr-Butler Cr
				sanitary	0.004	septic tank	80	60	Rocky Cr-Butler Cr
	UU	300	textile	scour & dye	0.030	screen	90,000	90,000	Savannah R
	VV	8	food	meat pk	0.002	grease trap	1,620	1,620	Rocky Cr-Butler Cr
	WW	65	food	meat pk	0.570	none	6,000	6,000	trib-Beaver Dam Cr
	XX	55	food	milk	0.080	none	2,720	2,720	Augusta canal-Savannah R
	ZZ	200	textile	sanitary	0.010	none	50	50	canal-Savannah R
	AAA	60	food	meat pk	0.018	none	360	360	canal-Savannah R
	CCC	65	food	cooling water	0.052	none	--	--	Oats Cr-Savannah R
	DDD	600	fire	proc&cooling	0.520	settling	--	--	ditch-Phinizy Cr-Savannah R
	EEE	400	textile	sanitary	0.002	none	200	200	canal-Savannah R
	FFF	102	metal	foundry	0.008	none	--	--	canal-Savannah R
				sanitary	0.005	none	50	50	canal-Savannah R
	GGG	1,250	textile	proc. &cooling	undet	none	500	500	canal-Savannah R
				sanitary	0.063	none	500	500	canal
	HHH	80	chemical	NaOH & cooling	0.090	lagoon	--	--	undetermined
				sanitary	0.004	septic tank	80	60	ditch-Savannah R
	III	400	pulp & paper	proc& cooling	17.000	stab. pond	150,000	30,000	Savannah R
				water plant sludge	1.500	stab. pond	--	--	Savannah R
	JJJ	85	food	veg. oil	0.001	none	undet	undet	Rhodes Cr-Savannah R
				cooling water	0.025	none	--	--	Rhodes Cr-Savannah R

TABLE P-2 (CONT'D)
BASIC DATA ON SOURCES OF INDUSTRIAL POLLUTION
(Excludes industries connected to municipal sewer systems)
SAVANNAH BASIN

Location by State and County	Code	Number of Employees	Type of Industry	Type of Waste	Estimated Average Flow mgd	Treatment Provided	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Discharged To
SOUTH CAROLINA									
Abbeville	A	1,200	textile	dye	1.500	none	4,250	4,250	Blue Hill Cr
	C	510	textile	dye & sanitary	0.610	stab. pond	20,500	3,000	Rocky R
Aiken	F	750	textile	sizing	0.001	none	50	50	Horse Cr
	G	1,000	textile	dye & sanitary	3.910	stab. pond	50,000	32,800	Little Horse Cr
	H	3,000	textile	dye & sizing	3.401	none	89,411	89,411	Horse Cr
	I	26	chemical	tex. chem.	0.002	none	18,240	18,240	Mockingbird Br-Horse Cr
Anderson	J	1,240	textile	process	0.001	none	120	120	Whitner Cr-Genrostee Cr
	K	371	textile	sizing	0.001	none	100	100	Cemetery Cr-Rocky R
	L	35	chemical	acids	0.016	neutralize	120	30	Whitner Cr-Generostee Cr
	O	4	food	meat pk	0.001	broad-irrig.	600	none	ground
	P	66	textile	process	0.600	none	4,020	4,020	Rocky R
	Q	1,400	textile	process & sanitary	0.337	chem. prec. & act. sludge	14,300	140	Betsy Cr-Rocky R
	R	23	food	dairy	0.008	septic tank	160	130	branch-Rocky R
	S	340	metal	paint & oil	0.025	chem. prec.	--	--	Whitner Cr-Generostee Cr
	T	50	laundry	process	0.038	none	200	200	RR ditch-Rocky R
				sanitary	0.001	septic tank	50	40	RR ditch-Rocky R
	U	543	textile	sizing	0.001	stab. pond	1,218	170	4 Mile Cr-Rocky R
	V	325	textile	sizing	0.001	none	25	25	Silverbrook Cr
	W	18	food	meat pk	0.004	septic tank	960	620	Wolf Cr-Rocky R
	Y	259	textile	dye	0.040	none	3,900	3,900	Cupboard Cr-Rocky R
	Z	750	textile	dye	1.100	none	4,500	4,500	23 Mile Cr-Hartwell Res
	AA	750	textile	dye & proc.	1.300	none	19,500	19,500	18 Mile Cr-Hartwell Res
				sanitary	0.005	primary	500	320	18 Mile Cr-Hartwell Res
	BB	500	textile	proc.& sant.	0.007	stab. pond	400	20	18 Mile Cr-Hartwell Res
	CC	300	textile	sanitary	0.018	septic tank	100	90	Shankline Cr-23 Mile Cr-Hartwell Res
	DD	240	textile	sizing	0.001	none	50	50	ditch
McCormick	FF	450	textile	dye & proc.	0.250	chem. prec.	4,000	3,000	Branch-Savannah R

TABLE P-2 (CONT'D)
BASIC DATA ON SOURCES OF INDUSTRIAL POLLUTION
(Excludes industries connected to municipal sewer systems)
SAVANNAH BASIN

Location by State and County	Code	Number of Employees	Type of Industry	Type of Waste	Estimated Average Flow mgd	Treatment Provided	Estimated PE (BOD)		Discharged To
							Untr'd Waste	Disch'd Waste	
SOUTH CAROLINA - cont'd									
Oconee	HH	402	textile	sanitary	0.002	none	300	300	Hartwell Res
	II	2,500	textile	dye & proc	3.000	none	34,000	34,000	Martin Cr-Hartwell Res
				sanitary	0.005	primary	1,000	650	Martin Cr-Hartwell Res
	JJ	300	textile	sizing & sanitary	0.009	none	300	300	Little R-Hartwell Res
	LL	400	textile	chemical	0.001	neutralize	--	--	Coneross Cr-Hartwell Res
	NN	175	textile	sizing	0.001	none	25	25	Coneross Cr-Hartwell Res
	OO	700	textile	dye	0.350	stab. pond	850	400	Oconee Mill Branch
Pickens	PP	280	textile	sizing	0.001	none	50	50	12 Mile Cr-Hartwell Res
				sanitary	0.003	septic tank	70	55	12 Mile Cr-Hartwell Res
	RR	750	textile	sizing & proc.	0.001	none	300	300	Golden Cr-12 Mile Cr-Hartwell Res
				sanitary	0.015	septic tank	700	630	Golden Cr-12 Mile Cr-Hartwell Res
	SS	40	food	canning	0.023	stab. pond	1,000	none	no waste discharge
	TT	415	textile	sizing	0.001	none	50	50	undetermined
	UU	440	textile	sizing	0.001	none	100	100	Brushy Cr-Hartwell Res
	WW	350	textile	dye	0.150	chem. prec.	1,200	200	18 Mile Cr-Hartwell Res
	YY	640	textile	dye	0.075	neut & filt	1,500	225	18 Mile Cr-Hartwell Res
	ZZ	74	textile	proc.& sanitary	0.004	septic tank	300	240	Town Cr-Hartwell Res
	AAA	400	textile	sizing	0.001	none	600	600	Town Cr-Hartwell Res
				sanitary	0.003	septic tank	400	320	Town Cr-Hartwell Res
	BBB	1,300	metal	metal prod.	0.100	none	--	--	Town Cr-Hartwell Res
				sanitary	0.010	primary	500	500	Town Cr-Hartwell Res
Totals					138.515		1,931,100	1,740,400	

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feet in depth have been reported in the river below Savannah. These sludge banks contain from 10 to 30 percent volatile matter on a dry weight basis.

Oyster and other shellfish growing areas in the lower Savannah Basin have been closed to commercial fishing because of contamination by sanitary wastes discharged to these areas. It is estimated that approximately 11,000 acres of coastal waters in the Savannah Basin are closed to commercial shellfishing.

Surveys conducted by the Georgia Game and Fish Commission have indicated that the Tallulah River and the Chattooga River in the upper portion of the Basin are free of pollution and that both are used for trout fishing. Organic and inorganic pollution has been reported in Eastonollee Creek which drains into the Tugaloo River below Yonah Dam. According to the Georgia Game and Fish Commission, the effects of this pollution have been severe in Eastanollee Creek but have not been serious in the Tugaloo River. Surveys conducted in the Savannah River show the river to be polluted in the Augusta and Savannah regions. Mine wastes from South Carolina and municipal and industrial wastes from Augusta and Savannah have been reported as the major sources of pollution in these two areas.

A recent survey by the Public Health Service conducted during November 1960, January and February 1961, and June 1961 showed that the average dissolved oxygen (D.O.) content of the river at a point below Augusta ranged from 78.9 to 90.0 percent of saturation. The lowest D.O. reported was 6.18 ppm during the summer survey. The coliform concentrations reported ranged from 4300 to 93,000 MPN per 100 ml. The beta radioactivity of the water was reported as ranging from 16.6 to 194.3 uuc/l for the dissolved fraction. These data are from the report on Water Quality Basic Data - Southeast River Basins, 1961 prepared by the Public Health Service for the U. S. Study Commission.

POLLUTION ABATEMENT REQUIREMENTS FOR 1960

SEWERAGE

At the present time, 32 municipalities in the Basin serve only part of their populations and 13 municipalities with populations of 800 or more have no sewage collection systems. The 32 municipalities with existing systems should extend their collection systems to serve an additional 56,500 persons including 19,300 in the Ogeechee Basin portion of the City of Savannah and 13 municipalities should construct new collection systems to serve 19,750 persons. The total capital outlay required as shown in Table P-3 is estimated to be $3,812,000.

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TREATMENT FACILITIES

The degree of treatment required at each municipality has been determined on the basis of dilution water available during periods of low stream flow and/or downstream water use. Dilution water requirements are discussed more fully in the LOW FLOW AUGMENTATION section of this memorandum.

Existing treatment facilities at 14 municipalities and institutions are adequate for present needs. These are Boggs Academy (Burke County), Chatham City, Fort Gordon, Savannah Beach, Sylvania, Travis Field at Savannah, Washington, and Waynesboro, Georgia; and, Abbeville, Cateechee, Due West, Easley, Graniteville, and Greenwood, South Carolina. However, as shown in the section on LOW FLOW AUGMENTATION, augmentation is necessary at Sylvania, Georgia and Graniteville and Greenwood, South Carolina.

There are 35 municipalities which presently do not provide treatment or have only septic tanks and should construct new treatment plants. Of this total, 7 should construct secondary treatment plants, 17 should construct stabilization ponds and the remaining 11 should construct primary treatment plants. Because of their geographic location and the topography of the area, the communities of Bath, Clearwater, Gloversville, Langley, and Madison in South Carolina have been combined in this study. It has been assumed that these communities will be served by one sewer system and one treatment plant which would discharge to the Savannah River.

There are 30 municipalities which should make either additions or enlargements to their existing treatment plants. Of these, seven should add secondary units to existing primary treatment plants. The total capital outlay required for needed new construction and additions to existing sewage treatment plants is estimated to be $24,085,000 as shown by Table P-3.

Industrial liquid waste disposal by 23 of the industries surveyed is adequate at present. However, the remaining 76 industries should provide more satisfactory methods of waste treatment and disposal. Thirty-nine of these industries could connect to nearby municipal sewer systems. Primary treatment should be provided by 5 of the industries, and 4 should provide secondary treatment. Stabilization ponds should be provided by 16 of the industries. Twelve other industries should provide either sedimentation, neutralization, chemical precipitation or other similar types of treatment. The total capital outlay required for industrial pollution abatement facilities in 1960 is estimated to be $9,495,000 as shown by Table P-4.

TABLE P-3
MUNICIPAL POLLUTION ABATEMENT
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

	Treatment Facilities		Estimated Costs in $1,000		
Municipality	Des'd for (1,000 PE)	Type Recommended	Sewerage	Treatment	Total
GEORGIA					
Alto Ind. Inst.	.65	secondary	--	18	18
Augusta	221.8	primary	--	4879	4879
Clayton	1.5	primary	15	81	96
Comer	.9	secondary	44	21	65
Commerce	12.0	primary	3	378	381
Elberton	7.1	primary	50	380	430
Franklin Spgs. Col.	.16	secondary	--	12	12
Garden City	6.0	primary	--	351	351
Gracewood Sch. for Mental Defectives	2.2	secondary	--	166	166
Grovetown	1.7	secondary	70	33	103
Harlem	1.7	secondary	4	190	194
Hartwell	5.4	secondary	40	575	615
Lavonia	2.5	secondary	5	316	321
Lincolnton	1.8	secondary	73	35	108
Pooler	1.5	secondary	54	31	85
Port Wentworth	4.0	primary	24	272	296
Richmond County	29.0	primary	500	1000	1500
Rincon	1.1	secondary	55	25	80
Royston	2.3	primary	17	179	196
Sardis	1.3	secondary	--	28	28
Savannah	181.8	primary	965	4100	5065
Springfield	1.25	primary	43	115	158
Sylvania	3.5	secondary	24	--	24
Thomason	5.0	secondary	35	222	257
Thunderbolt	1.9	primary	96	158	254
Toccoa	8.2	secondary	65	744	809
Toccoa Falls Sch.	.4	secondary	--	14	14
Washington	5.1	secondary	82	--	82
Waynesboro	5.5	secondary	48	--	48
Wrens	2.0	secondary	42	104	146
SOUTH CAROLINA					
Aiken	22.5	secondary	--	700	700
Anderson	49.3	secondary	278	2363	2641

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TABLE P-3 (CONT'D)
MUNICIPAL POLLUTION ABATEMENT
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

	Treatment Facilities		Estimated Costs in $1,000		
Municipality	Des'd for (1,000 PE)	Type Recommended	Sewerage	Treatment	Total
SOUTH CAROLINA - cont'd.					
Arial	1.1	secondary	5	25	30
Bath Clearwater Gloversville Langley Madison	77.2	primary	209	1821	2030
Belton	5.3	secondary	55	550	605
Calhoun Falls	3.0	primary	--	222	222
Central	1.7	secondary	15	33	48
Clemson	1.6	secondary	45	229	274
Clemson College	4.0	secondary	--	458	458
Due West	1.2	secondary	8	--	8
Edgefield	4.0	secondary	54	61	115
Gluck	.25	secondary	--	12	12
Greenwood	14.0	secondary	226	--	226
Honea Path	1.2	secondary	13	70	83
Iva	1.5	secondary	--	31	31
Jackson	2.0	secondary	90	37	127
Liberty	2.7	primary	33	200	233
McCormick	6.0	primary	20	292	312
New Ellenton	2.3	secondary	116	41	157
Newry	2.0	secondary	--	268	268
North Augusta	16.3	primary	--	660	660
Pendleton	2.4	secondary	120	44	164
Pickens	3.7	primary	20	181	201
Seneca	5.2	secondary	86	555	641
Utica	1.3	secondary	65	28	93
Walhalla	3.5	secondary	--	415	415
Westminster	3.9	secondary	--	362	362
Totals			3812	24,085	27,897

TABLE P-4
INDUSTRIAL POLLUTION ABATEMENT
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

Location by State and County	Code	Type of Waste	Treatment Recommended	Est. Cost of Treatment $1,000
GEORGIA				
Banks	A	Meat packing	Stabilization pond	18
Chatham	C	Pulp and paper	Primary	240
	D	Asphalt	City sewers	--
	E	Meat packing	City sewers	--
	F	Naval stores	City sewers	--
	I	Felt and roofing	Primary	75
	K	Metal fabrication	City sewers	--
	L	Meat packing	Stabilization pond	24
	M	Chemical	Neutralization	33
	N	Chemical	Neutralization	18
	P	Chemical	Neutralization	1,125
	Q	Food processing	Primary	1,655
	R	Gypsum	Sedimentation	10
	S	Pulp and paper	Primary	2,500
	T	Meat packing	City sewers	--
	U	Naval stores	City sewers	--
	V	Meat packing	City sewers	--
	W	Felt and roofing	Stabilization pond	35
	Y	Chemical	Stabilization pond	78
	Z	Chemical	Neutralization	122
	AA	Vegetable Oil	Chemical prec	95
	BB	Metal	Chemical prec	10
Elbert	CC	Stone	Sedimentation	100
	DD	Textile	Primary	67
Franklin	EE	Textile	Stabilization pond	10
Lincoln	HH	Poultry	Broad Irrigation	negligible
Madison	II	Poultry	City sewers	--
McDuffie	LL	Poultry	Stabilization pond	6
Oglethorpe	MM	Poultry	Stabilization pond	6
Screven	NN	Meat packing	City sewers	--
Stephens	OO	Textile	Secondary	108
	QQ	Metal fabrication	City sewers	--
Richmond	SS	Chemical	City sewers	--

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TABLE P-4 (CONT'D)
INDUSTRIAL POLLUTION ABATEMENT
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

Location by State and County	Code	Type of Waste	Treatment Recommended	Est. Cost of Treatment $1,000
GEORGIA				
Richmond	TT	Lumber	Chemical precipitation	60
	UU	Textile	City sewers	--
	VV	Meat packing	Stabilization pond	16
	WW	Meat packing	Stabilization pond	41
	XX	Dairy	City sewers	--
	ZZ	Textile	City sewers	--
	AAA	Meat packing	City sewers	--
	CCC	Food	City sewers	--
	EEE	Textile	City sewers	--
	FFF	Metal	City sewers	--
	GGG	Textile	City sewers	--
	JJJ	Vegetable oil	City sewers	--
SOUTH CAROLINA				
Abbeville	A	Textile	Stabilization pond	32
Aiken	F	Textile	City sewers	--
	G	Textile	City sewers	--
	H	Textile	Secondary	1,090
	I	Chemical	City sewers	--
Anderson	J	Textile	City sewers	--
	K	Textile	City sewers	--
	O	Meat packing	Broad irrigation	negligible
	P	Textile	Stabilization pond	31
	R	Dairy	City sewers	--
	S	Metal fabrication	City sewers	--
	T	Laundry	City sewers	--
	V	Textile	City sewers	--
	W	Meat packing	Stabilization pond	12
	Y	Textile	Stabilization pond	31
	Z	Textile	Stabilization pond	33
	AA	Textile	Secondary	700
	BB	Textile	City sewers	--
	CC	Textile	City sewers	--
McCormick	FF	Textile	City sewers	--
Oconee	HH	Textile	City sewers	--
	II	Textile	Secondary	1,090
	JJ	Textile	Stabilization pond	6

TABLE P-4 (CONT'D)
INDUSTRIAL POLLUTION ABATEMENT
ESTIMATED NEEDS AND COSTS* FOR 1960
SAVANNAH BASIN

Location by State and County	Code	Type of Waste	Treatment Recommended	Est. Cost of Treatment $1,000
SOUTH CAROLINA (Cont'd)				
Oconee	NN	Textile	Septic tank - tile field	1
	OO	Textile	Additional stabilization pond	5
Pickens	PP	Textile	City sewers	--
	RR	Textile	City sewers	--
	TT	Textile	City sewers	--
	UU	Textile	City sewers	--
	ZZ	Textile	City sewers	--
	AAA	Textile	City sewers	--
	BBB	Metal	Chemical precipitation	12
Total				$ 9,495

*Based on January 1960 constant dollars

OTHER NEEDS

A need exists in the Savannah Basin and other areas of the Southeast River Basins for research and studies to determine the effect of pollution from insecticides, pesticides, and herbicides, and methods for its control.

A need also exists for pollution abatement measures to alleviate pollution in several coastal water areas now closed to commercial shellfish harvesting. A comprehensive study should be made to determine the sources and extent of the problems and to determine the economic feasibility of industrial and municipal sewage treatment required to adequately abate the pollution.

A field survey is needed to determine the effects of the discharges of municipal and industrial wastes from the Savannah, Georgia area on the downstream tidewater reaches of the Savannah River. Information obtained in such a survey should include volume and strength of sources of waste discharges in the Savannah area, their effects on water quality, stream flow and tidal characteristics of the lower Savannah River and their effects upon water quality. With this type of information available, the degree of treatment required and the need for stream flow or tidewater control structures, if any, could be determined for the abatement of the pollution of the lower Savannah River.

FUTURE POLLUTION ABATEMENT REQUIREMENTS

PROJECTIONS

There are 68 municipalities and institutions expected to have sewage works by 1975. As shown in Table P-5, the total PE of the sewage before treatment will be 977,900 and the PE after recommended treatment is estimated to be 489,500.

By the year 2000, these same 68 municipalities and institutions are expected to have sewage works. As shown in Table P-5, the total PE of the sewage before treatment will be 1,393,800 and the estimated PE after recommended treatment will be 697,000.

As shown in Table P-6, industrial wastes discharged by 41 industries will have a total PE before treatment of 2,064,800 and 2,444,600 by 1975 and 2000, respectively. The wastes will have an estimated total PE after recommended treatment of 959,900 and 1,230,000 by 1975 and 2000 respectively. These figures do not include 21 industries for which waste discharges are either undetermined or of an inorganic nature. It is assumed that all other industries in the Basin will discharge wastes to subsurface systems, evaportation ponds or to municipal sewerage systems.

SEWERAGE

Assuming that sewerage requirements for 1960 will have been met, additional sewerage construction will be required in 45 municipalities between 1960 and 1975. These 45 municipalities will require extension of the sewage collection systems recommended for 1960 to serve an additional 105,800 persons. As shown by Table P-7, the total capital outlay required for extension of sewerage systems between 1960 and 1975 is estimated to be $5,290,000.

Between 1975 and 2000, there will be a need for sewerage construction in 48 municipalities. These municipalities will require extension of the sewage collection systems recommended in 1960 and 1975 to serve an additional 256,600 persons. As shown by Table P-7, the total outlay required for extension of the sewage collection systems required to meet these needs is estimated to be $12,831,000.

TREATMENT FACILITIES

The degree of treatment required at each municipality, institution, and industry has been determined on the basis of dilution water available during periods of low stream flow and/or downstream water use. In those upstream areas where low flows are not sufficient to protect water quality after secondary treatment, low flow augmentation is recommended. However, primary treatment only has been recommended for wastes discharged to tidewater.

These areas are discussed more fully in the LOW FLOW AUGMENTATION section of this memorandum.

The sewage treatment facilities recommended for 1960 in 27 municipalities will be adequate to meet the needs between 1960 and 1975. Twenty-three other municipalities, however, should enlarge the treatment facilities recommended for 1960, and two municipalities will need to enlarge their existing facilities to meet the needs between 1960 and 1975. Eight of the plant enlargements are for primary plants and 17 are for secondary plants. The total capital outlay required for municipal sewage treatment plant construction between 1960 and 1975 is estimated to be $9,284,000 as shown by Table P-7.

Treatment facilities recommended for 1960 will be adequate to meet 1975 needs for nine industries. However, 29 industries will need additional waste treatment facilities between 1960 and 1975. The total capital outlay required for this construction is estimated to be $4,468,000 as shown by Table P-8.

Sewage treatment facilities recommended for the 25 municipalities for 1975 should be enlarged to meet needs between 1975 and 2000. In addition, 14 municipalities will need to enlarge their existing or recommended 1960 plants. The total capital outlay required for municipal sewage treatment facilities needed between 1975 and 2000 is estimated to be $18,740,000 as shown by Table P-7.

The waste treatment facilities recommended for the 29 industries for 1975 should be expanded to meet needs between 1975 and 2000. In addition, three industries will need to expand existing or 1960 recommended facilities to meet the needs between 1975 and 2000. The total capital outlay required for this expansion is estimated to be $6,612,000 as shown by Table P-8.

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TABLE P-5
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SAVANNAH BASIN

Municipality	1975 Treatment Recommended	1975 PE Untreated Waste	1975 PE Discharged Waste	2000 Treatment Recommended	2000 PE Untreated Waste	2000 PE Discharged Waste
GEORGIA						
Alto Industrial Inst.	Secondary	650	100	Secondary	650	100
Augusta	Primary	273,100	177,000	Primary	453,600	294,000
Boggs Academy	Secondary	200	30	Secondary	200	30
Chatham City	Primary	1,800	1,200	Primary	1,800	1,200
Clayton	Primary	3,250	2,120	Primary	3,975	2,580
Comer	Secondary	850	130	Secondary	750	110
Commerce	Primary	12,000	7,800	Primary	13,500	8,700
Elberton	Primary	8,900	5,800	Secondary	16,000	2,400
Fort Gordon	Secondary	12,365	1,850	Secondary	12,365	1,850
Franklin Springs College	Secondary	160	25	Secondary	160	25
Garden City	Primary	6,000	3,900	Primary	8,500	5,500
Gracewood School for Mental Defectives	Secondary	2,000	300	Secondary	2,000	300
Gracewood School for Boys	Secondary	210	30	Secondary	210	30
Grovetown	Secondary	1,700	260	Secondary	2,300	350
Harlem	Secondary	1,900	290	Secondary	3,150	470
Hartwell	Secondary	6,900	1,030	Secondary	17,000	2,550
Homer	Secondary	950	140	Secondary	1,600	240
Lavonia	Secondary	2,450	370	Secondary	3,250	490
Lincolnton	Secondary	1,800	270	Secondary	2,600	390

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TABLE P-5 (CONT'D)
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SAVANNAH BASIN

	1975			2000		
Municipality	Treatment Recommended	PE Untreated Waste	PE Discharged Waste	Treatment Recommended	PE Untreated Waste	PE Discharged Waste
GEORGIA (Cont'd)						
Pooler	Secondary	1,550	230	Secondary	2,900	440
Port Wentworth	Primary	4,000	2,600	Primary	5,600	3,600
Richmond County	Primary	29,000	19,000	Primary	29,000	19,000
Rincon	Secondary	1,900	290	Secondary	5,000	750
Royston	Primary	3,000	1,950	Secondary	4,700	700
Sardis	Secondary	1,000	150	Secondary	1,300	200
Savannah	Primary	220,000	143,000	Primary	289,300	187,000
Savannah Beach	Primary	3,000	1,950	Primary	4,500	2,920
Springfield	Primary	1,250	810	Primary	1,800	1,200
Sylvania	Secondary	4,800	720	Secondary	8,400	1,260
Thomson	Secondary	7,000	1,050	Secondary	18,400	2,760
Thunderbolt	Primary	3,000	1,950	Primary	6,300	4,100
Toccoa	Secondary	9,100	1,360	Secondary	16,500	2,480
Toccoa Falls Institute	Secondary	400	60	Secondary	400	60
Travis Air Field	Primary	1,500	970	Primary	1,500	970
Washington	Secondary	5,900	970	Secondary	7,600	1,150
Waynesboro	Secondary	6,200	930	Secondary	8,000	1,200
Wrens	Secondary	2,000	300	Secondary	2,[illegible]00	400
SOUTH CAROLINA						
Abbeville	Secondary	6,100	920	Secondary	7,300	1,100
Aiken	Secondary	22,500	3,400	Secondary	22,500	3,400

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TABLE P-5 (CONT'D)
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SAVANNAH BASIN

Municipality	1975			2000		
	Treatment Recommended	PE Untreated Waste	PE Discharged Waste	Treatment Recommended	PE Untreated Waste	PE Discharged Waste
SOUTH CAROLINA (Cont'd)						
Anderson	Secondary	116,000	17,400	Secondary	127,600	19,100
Arial	Secondary	1,100	165	Secondary	100	165
Bath)	Primary	76,600	49,600	Primary	74,600	48,500
Clearwater)						
Glovensville)						
Langley)						
Madison)						
Belton	Secondary	7,300	1,100	Secondary	17,700	2,660
Calhoun Falls	Primary	3,000	1,950	Primary	4,100	2,700
Cateechee	Primary	715	470	Primary	700	450
Central	Secondary	1,550	230	Secondary	1,650	250
Clemson	Secondary	2,200	330	Secondary	3,900	590
Clemson College	Secondary	5,000	750	Secondary	7,000	1,050
Due West	Secondary	1,600	240	Secondary	2,800	420
Easley Pt #3	Secondary	2,500	380	Secondary	4,000	600
Edgefield	Secondary	4,000	600	Secondary	5,000	750
Gluck	Secondary	250	38	Secondary	250	38
Graniteville	Secondary	5,000	750	Secondary	5,000	750
Greenwood	Secondary	16,500	2,500	Secondary	19,500	2,900
Honea Path	Secondary	1,900	290	Secondary	2,700	400
Iva	Secondary	1,400	210	Secondary	1,500	230
Jackson	Secondary	1,800	270	Secondary	2,000	300
Liberty	Primary	3,000	1,950	Primary	3,600	2,300

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TABLE P-5 (CONT'D)
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SAVANNAH BASIN

Municipality	1975			2000		
	Treatment Recommended	PE Untreated Waste	PE Discharged Waste	Treatment Recommended	PE Untreated Waste	PE Discharged Waste
SOUTH CAROLINA (Cont'd)						
McCormick	Primary	6,400	4,150	Primary	6,900	4,480
New Ellenton	Secondary	2,300	345	Secondary	2,300	345
Newry	Secondary	1,970	300	Secondary	1,970	300
North Augusta	Primary	21,100	13,600	Secondary	64,000	41,500
Pendleton	Secondary	3,500	520	Secondary	7,000	1,050
Pickens	Primary	3,700	2,400	Primary	6,500	4,200
Seneca	Secondary	8,800	1,320	Secondary	18,800	2,820
Utica	Secondary	2,200	330	Secondary	5,100	770
Walhalla	Secondary	4,100	620	Secondary	5,600	840
Westminister	Secondary	3,000	450	Secondary	3,600	540
Totals		977,900	489,500		1,393,800	697,000

TABLE P-6
SOURCES OF INDUSTRIAL WASTE - 1975 AND 2000
(Excludes industries connected to municipal sewer systems)
SAVANNAH BASIN

Location by State and County	Code	Treatment Recommended	1975			2000		
			Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste	Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste
GEORGIA								
Banks	A	stabilization pond	0.005	3,060	460	0.008	5,100	765
Chatham	B	oil separation	0.006	110	90	0.007	140	110
	C	primary	19.000	90,000	58,500	19.000	90,000	58,500
	G	pond	0.035	undet	undet	0.052	undet	undet
	H	settling	0.004	--	--	0.006	--	--
	I	primary	0.580	17,900	11,600	0.800	24,700	16,000
	J	oil sep.	1.700	--	--	2.340	--	--
	L	stabilization pond	0.157	3,960	595	0.217	5,720	860
	M	neutralization	0.810	--	--	1.130	--	--
	N	neutralization	0.186	--	--	0.248	--	--
	O	neutralization	0.120	--	--	0.160	--	--
	P	neutralization	28.800	--	--	39.400	--	--
	Q	primary	3.750	225,000	146,000	5.500	330,000	214,000
	R	settling	0.029	--	--	0.054	--	--
	S	primary	40.000	1,110,000	720,000	40.000	1,110,000	720,000
	W	stabilization pond	0.086	5,800	870	0.120	8,100	1,210
	Y	stabilization pond	2.000	undet	undet	2.800	undet	undet
	Z	neutralization	0.860	--	--	1.150	--	--
	AA	chemical prec.	1.970	undet	undet	2.940	undet	undet
	BB	chemical prec.	0.004	--	--	0.011	--	--
	New[1].	primary	20.000	170,000	59,500	44.500	370,000	130,000
	New[2].	chemical prec.	--	--	--	1.500	--	--
	New[3].	settling	--	--	--	5.000	--	--
Elbert	CC	settling	1.050	--	--	1.920	--	--
	DD	primary	0.180	1,430	930	0.155	1,220	795
Franklin	EE	stabilization pond	0.038	720	10	0.033	610	10
Hart	FF	settling	2.800	--	--	4.000	--	--
	New[1].	secondary	7.000	58,300	8,700	16.800	140,000	21,000
	GG	oil separation	0.175	--	--	0.500	--	--

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TABLE P-6 (CONT'D)
SOURCES OF INDUSTRIAL WASTE - 1975 AND 2000
(Excludes industries connected to municipal sewer systems)
SAVANNAH BASIN

Location by State and County	Code	Treatment Recommended	1975			2000		
			Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste	Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste
GEORGIA - cont'd								
Lincoln	HH	broad irrigation	0.007	280	0	0.010	450	0
Madison	JJ	septic tank	0.005	75	60	0.008	125	100
McDuffy	LL	secondary	0.007	110	15	0.006	85	15
Oglethorpe	MM	secondary	0.047	870	130	0.040	760	115
Stephens	OO	secondary	1.820	7,600	1,140	1.560	6,600	990
	PP	settling	0.244	--	--	0.700	--	--
Richmond	RR	septic tank	0.003	100	80	0.006	200	160
	TT	chemical prec.	0.234	90	50	0.300	115	75
	VV	stab. pond	0.005	4,050	610	0.008	6,100	910
	WW	primary	0.880	15,400	10,000	1.270	22,300	14,500
	DDD	settling	0.955	--	--	1.300	--	--
	HHH	lagoon	0.110	--	--	0.158	--	--
	III	stabilization pond	18.500	150,000	22,500	18.500	150,000	22,500
SOUTH CAROLINA								
Abbeville	A	stabilization pond	1.460	4,150	620	1.220	3,500	530
	C	stabilization pond	0.600	20,000	3,000	0.500	17,000	3,000
Aiken	H	secondary	3.300	86,500	13,000	2.780	73,000	11,000
Anderson	L	neutralization	0.017	125	35	0.023	170	45
	O	broad irrigation	0.002	900	0	0.002	1,200	0
	P	stabilization pond	0.600	4,000	600	0.005	3,350	500
	Q	secondary	0.328	13,900	2,080	0.276	11,700	1,760
	U	stabilization pond	0.006	1,720	260	0.005	1,460	220
	W	stabilization pond	0.006	1,360	200	0.008	1,900	285
	Y	stabilization pond	0.038	3,760	560	0.032	3,160	475
	Z	stabilization pond	1.070	4,450	670	0.900	3,760	550
	AA	secondary	1.270	19,500	2,920	1.070	16,400	2,460
Oconee	II	secondary	2.880	33,600	5,050	2.460	28,700	4,300

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TABLE P-6 (CONT'D)
SOURCES OF INDUSTRIAL WASTE - 1975 AND 2000
(Excludes industries connected to municipal sewer systems)
SAVANNAH BASIN

Location by State and County	Code	Treatment Recommended	1975 Vol. of Waste mgd	1975 PE Untreated Waste	1975 PE Discharged Waste	2000 Vol. of Waste mgd	2000 PE Untreated Waste	2000 PE Discharged Waste
SOUTH CAROLINA - cont'd								
Oconee	JJ	stabilization pond	0.008	290	45	0.007	245	40
	LL	neutralization	0.001	--	--	0.001	--	--
	OO	stabilization pond	0.340	825	125	0.290	700	105
Pickens	SS	stabilization pond	0.032	1,350	200	0.043	1,850	280
	WW	chemical prec.	0.145	1,170	600	0.120	980	490
	YY	secondary	0.063	1,460	220	0.062	1,230	185
	BBB	chemical prec.	0.185	850	550	0.440	2,000	1,300
Totals			166.513	2,064,800	959,900	224.461	2,444,600	1,230,000

1. Pulp and Paper
2. Chemical
3. Glass

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TABLE P-7
MUNICIPAL POLLUTION ABATEMENT
ESTIMATED COSTS* - 1975 AND 2000
SAVANNAH BASIN

	Estimated Costs in $1,000					
	1975			2000		
Municipality	Sewerage	Treatment	Total	Sewerage	Treatment	Total
GEORGIA						
Augusta	480	1,530	2,010	953	4,160	5,113
Clayton	73	164	237	36	67	103
Commerce	16	--	16	31	134	165
Elberton	--	152	152	205	1,023	1,228
Garden City	28	--	128	125	193	318
Grovetown	15	--	15	30	18	48
Harlem	24	--	24	63	194	257
Hartwell	115	219	334	335	865	1,200
Homer	48	24	72	33	18	51
Lavonia	18	--	18	40	140	180
Lincolnton	18	--	18	40	20	60
Pooler	24	--	24	18	30	48
Port Wentworth	15	--	15	80	140	220
Rincon	40	20	60	105	52	157
Royston	25	81	106	85	384	469
Sardis	9	--	9	15	--	15
Savannah	1,760	1,235	2,995	3,114	1,725	4,839
Savannah Beach	--	--	--	75	--	75
Springfield	18	--	18	28	74	102
Sylvania	67	--	67	180	415	595
Thomson	24	268	292	385	935	1,320
Thunderbolt	54	108	162	165	230	395
Toccoa	90	154	244	205	793	998
Washington	38	--	38	85	--	85
Waynesboro	42	--	42	90	--	90
Wrens	19	--	19	35	127	162
SOUTH CAROLINA						
Abbeville	5	--	5	60	--	60
Anderson	1,094	3,260	4,354	2,215	975	3,190
Belton	150	317	467	350	913	1,263
Calhoun Falls	5	--	5	55	108	163
Central	4	--	4	5	--	5
Clemson	31	115	146	85	239	324

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TABLE P-7 (CONT'D)
MUNICIPAL POLLUTION ABATEMENT
ESTIMATED COSTS* - 1975 AND 2000
SAVANNAH BASIN

	Estimated Costs in $1,000					
	1975			2000		
Municipality	Sewerage	Treatment	Total	Sewerage	Treatment	Total
SOUTH CAROLINA - cont'd						
Clemson College	--	166	166	--	268	268
Due West	22	--	22	60	71	131
Easley	32	115	147	75	219	294
Edgefield	21	--	21	50	23	73
Greenwood	75	219	294	150	367	517
Honea Path	20	127	147	35	140	175
Iva	2	--	2	5	--	5
Jackson	3	--	3	10	--	10
Liberty	17	46	63	30	74	104
McCormick	20	58	78	60	71	131
North Augusta	405	324	729	2,145	1,376	3,521
Pendleton	57	25	82	175	415	590
Pickens	10	--	10	150	210	360
Seneca	179	420	599	310	865	1,175
Utica	45	22	67	145	450	595
Walhalla	33	115	148	75	219	294
Westminister	--	--	--	30	--	30
Totals	5,290	9,284	14,574	12,831	18,740	31,571

*Based on January 1960 constant dollars.

TABLE P-8
INDUSTRIAL POLLUTION ABATEMENT ESTIMATED COSTS* - 1975 AND 2000 SAVANNAH BASIN

Location by State and County	Code	Estimated Costs in $1,000	
		1975	2000
GEORGIA			
Banks	A	12	18
Chatham	H	--	10
	I	100	189
	J	26	77
	L	15	25
	M	13	21
	N	22	30
	O	6	8
	P	171	495
	Q	880	1,240
	R	10	15
	W	10	20
	Y	31	47
	Z	46	71
	AA	115	158
	New[1]	1,870	1,870
	New[2]	--	254
	New[3]	--	600
Elbert	CC	35	50
Hart	FF	172	150
	New[1]	700	980
	GG	22	53
Stephens	PP	26	63
Richmond	RR	5	5
	TT	15	20
	VV	22	19
	WW	52	43
	DDD	62	35
	HHH	5	8
SOUTH CAROLINA			
Anderson	W	7	9
Pickens	SS	6	8
	BBB	12	21
Total		4,468	6,612

*Based on January 1960 constant dollars.

1. Pulp and Paper
2. Chemical
3. Glass

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LOW FLOW AUGMENTATION

GENERAL

A minimum standard of water quality for fish and aquatic life is a dissolved oxygen content of not less than 4 ppm. In determining the volume of stream flow and storage required to maintain this standard, the following assumptions were used:

1. Summer water temperatures.
2. Minimum flows are 7 day low flows occurring once in 10 years.
3. Physical characteristics and reaeration constant of streams vary as to location, size, etc. of stream.

Minimum stream flows required at locations in the Basin where liquid wastes are discharged were calculated on the basis of the estimated PE for the years 1960, 1975, and 2000. At least primary treatment was assumed for all locations, and if they required dilution flow exceeded the actual low flow, secondary treatment was recommended. The minimum flows are shown in Table P-9. Locations requiring minimum flows of less than 1.0 cfs by the year 2000 are not included in the table.

TABLE P-9
MINIMUM FLOW REQUIREMENTS
SAVANNAH BASIN

General Location	Receiving Stream	Water Required (cfs)		
		1960	1975	2000
GEORGIA				
Augusta[1]	Savannah R	1556.0	1937.0	3072.0
Richmond County[1]	trib-Savannah R	174.2	174.6	175.2
North Augusta, S.C.[1]	Savannah R	97.8	127.0	379.8
Total for Savannah River at Augusta		1828.0	2238.6	3627.0
Clayton[1]	Stekoa Cr-Chattoga R	2.0	3.6	4.4
Commerce[1]	Beaver Dam Cr-Grove Cr-Hudson R	12.7	13.2	14.9
Elberton[2]	trib-Beaverdam Cr-Savannah R	9.6	11.3	2.9
Fort Gordon	Spirit Cr-Savannah R	3.7	3.7	3.7
Gracewood School	Spirit Cr-Savannah R	.6	.6	.6
Total for Spirit Cr		4.3	4.3	4.3
Hartwell	Cedar Cr-Savannah R	0.5	0.7	1.7
Hartwell (ind.)	Savannah R	--	36.0	86.4
Royston[2]	Beaverdam Cr-Savannah R	2.5	3.3	0.5
Rincon	Polly Cr-Savannah R	0.5	0.6	1.5
Savannah[1,3]	Savannah R	22418.0	31370.0	42735.0
Chatham City[1,3]	ditch-Savannah R	26.0	26.0	26.0
Garden City[1,3]	Savannah R	68.5	86.5	122.0
Port Wentworth[1,3]	Savannah R	53.0	57.5	80.6
Total for Savannah R at Savannah		22565.5	31541.0	42963.6
Savannah Beach[1,3]	Savannah	43.2	43.2	65.0
Springfield	Ebenezer Cr-Savannah R	2.1	3.0	4.3
Sylvania	Bucks Cr-Savannah R	1.0	--	--
Thomson	trib-Big Briar Cr-Savannah R	1.4	2.1	5.5
Thunderbolt[1,3]	Wilmington R	27.4	43.3	90.9

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TABLE P-9 (CONT'D)
MINIMUM FLOW REQUIREMENTS
SAVANNAH BASIN

General Location	Receiving Stream	Water Required (cfs) 1960	1975	2000
GEORGIA - Cont'd				
Toccoa	Toccoa Cr-Hartwell Res	0.8	0.9	1.7
Waynesboro	br-Briar Cr-Savannah R	1.6	1.9	2.4
SOUTH CAROLINA				
Abbeville	Parkens Cr-Blue Hill Cr-Little R	1.0	1.0	1.0
Aiken	Wilkenson Cr-Horse Cr	6.8	6.8	6.8
Anderson	Rocky Cr-Savannah R	7.0	13.8	14.8
Bath[1] Clearwater[1] Gloversville[1] Langley[1] Madison[1]	Savannah R	464.0	459.0	449.0
Belton	Hencoop Cr-Rocky R	0.3	0.5	1.1
Belton	Cupboard Cr-Rocky R	0.6	0.6	1.0
Calhoun Falls[1]	br-Savannah R	3.2	3.3	4.5
Calhoun Falls[1] (ind.)	Rocky R-Savannah R	22.5	22.0	18.7
Clemson	Hartwell Res	--	--	--
Easley	18 Mile Cr-Hartwell Res	3.4	3.3	3.0
Graniteville	Horse Cr-Reservoir	28.3	27.4	23.4
Greenwood	Hardlabor Cr-Stevens Cr	1.4	1.8	2.0
LaFrance	23 Mile Cr-Hartwell Res	--	--	--
Liberty[1]	12 Mile Cr-Hartwell Res	2.8	3.3	4.0
McCormick[1]	Rocky Cr-Stevens Cr	6.6	7.1	7.6

TABLE P-9 (CONT'D)
MINIMUM FLOW REQUIREMENTS
SAVANNAH BASIN

General Location	Receiving Stream	Water Required (cfs)		
		1960	1975	2000
SOUTH CAROLINA - Cont'd				
Pickens[1]	12 Mile Cr-Hartwell Res	4.4	5.0	9.4
Seneca	Martin Cr-Hartwell Res	0.5	0.9	1.9

[1] Primary treatment only.
[2] Should provide secondary treatment by 2000.
[3] Discharge to tidewater.

(5/1/62)

AREAS WHERE AUGMENTATION IS NOT NEEDED

There will be adequate volumes of water available, and no storage will be needed to maintain desirable water quality in streams below the point of wastes discharges (after recommended treatment) from the following areas: Augusta, Clayton, Fort Gordon, Royston, Waynesboro, and Springfield in Georgia; and Abbeville, Calhoun Falls, Easley, Liberty, North Augusta, and Pickens in South Carolina.

AREAS WHERE AUGMENTATION IS NEEDED

In several areas, the streams receiving liquid wastes travel a few miles (1-5) before reaching a larger stream with adequate flow. This results in severely polluted stream conditions for a short distances during periods of low flow in the following areas: Commerce, Elberton, Richmond County, Rincon, and Thomson in Georgia; and Belton, McCormick, and Seneca in South Carolina. Storage for low flow augmentation or higher degree of treatment to maintain desirable water quality in the short distances involved is not considered the most economical solution to the pollution problems which will exist in these areas. Studies of alternate solutions such as diversion will be needed in these areas.

Waste discharges at other areas in the Basin present greater problems, however, and are discussed individually below. In those areas where they is insufficient drainage area to provide needed storage for low flow augmentation and where alternate sources of dilution water are not readily available, further study will be needed to adequately determine the remedial measurer required to abate the anticipated pollution.

Tidewater Areas

Wastes from the Savannah Metropolitan area, which includes Chatham City, Garden City, Port Wentworth, Savannah, Savannah Beach, and Thunderbolt, are discharged to tidewater. Primary treatment has been recommended as a minimum requirement. Augmentation, however, is seldom the solution to tidewater pollution. Other measures, such as better dispersion of wastes by properly designed outfalls, controlled discharge to take full advantage of tidal movement, etc., are generally better solutions to tidewater pollution problems. The Savannah area will require a separate detailed study to determine pollution abatement requirements.

Hartwell, Georgia

Liquid wastes from Hartwell are presently discharged to both Lightwood Log Creek and Cedar Creek. To avoid polluting Hartwell

Reservoir which will inundate Lightwood Log Creek, all wastes should be diverted to Cedar Creek which has a natural low flow of 1.0 cfs. Wastes from Hartwell will require, after secondary treatment, stream flows of 0.5 cfs, 0.7 cfs, and 1.7 cfs in 1960, 1975, and 2000 respectively. If necessary, dilution water from Hartwell Reservoir may be diverted to Cedar Creek to avoid undesirable stream degradation.

Sylvania, Georgia

Liquid wastes from Sylvania are discharged after secondary treatment to Buck's Creek where there is little or no natural flow during dry periods. The wastes require 1.0 cfs, 1.4 cfs, and 2.5 cfs in 1960, 1975, and 2000 respectively. There is no possibility of providing storage on Buck's Creek above the point of waste discharge. To avoid serious degradation of water quality, all wastes should be diverted 3 miles to Ogeechee Creek in the Ogeechee Basin. The natural low flow of Ogeechee Creek is 4.0 cfs which is ample to dilute the wastes.

Toccoa, Georgia

Liquid wastes from Toccoa are discharged to both Eastanollee Creek and Toccoa Creek. To avoid serious degradation of Eastanollee Creek, all wastes should be discharged to Toccoa Creek where the natural low flow is 3.0 cfs. The wastes from Toccoa require, after secondary treatment, 0.8 cfs, 0.9 cfs, and 1.7 cfs in 1960, 1975, and 2000 respectively.

Aiken, South Carolina

Liquid wastes from Aiken are discharged to Wilkerson Creek which has little or no natural flow during dry periods. To avoid degradation of water quality in Wilkerson Creek, a large portion of the wastes from Aiken should be diverted approximately 3 miles to Shaws Creek which is in the Edisto Basin outside the SERB study area. The natural low flow in Shaws Creek will be ample for dilution of Aiken wastes after secondary treatment.

Anderson, South Carolina

Liquid wastes from Anderson are discharged to both Generostee Creek and Rocky River. The wastes require, after secondary treatment, stream flows of 7.0 cfs, 13.8 cfs, and 14.8 cfs in 1960, 1975, and 2000 respectively. There is little or no flow in Generostee Creek during dry periods. All wastes should be discharged to Rocky River where augmentation will be needed to maintain desired stream quality The storage required on Rocky River will be 60, 1560, and 1980 acre-feet in 1960, 1975, and 2000 respectively.

Bath-Langley Area, South Carolina

Liquid wastes from Bath, Clearwater, and Langley in South Carolina are discharged to Horse Creek where the low flow is insufficient to maintain desirable water quality. In addition, wastes from Gloversville and Madison are expected to be discharged to Horse Creek in the future. To avoid serious pollution of the several reservoirs on Horse Creek, all wastes from Bath, Langley, Clearwater, Gloversville, and Madison could be collected and diverted, probably by gravity flow, to one primary treatment plant which would discharge to the Savannah River where the flow is ample for dilution.

Greenwood, South Carolina

A portion of the liquid wastes from Greenwood are discharged to Hardlabor Creek at a point where there is little or no natural flow during dry periods. There is no possibility of providing storage for augmentation above the point of wastes discharge. As a result, Hardlabor Creek will be seriously polluted for approximately 10 miles during periods of low flow to a point where ample flow becomes available.

Graniteville, South Carolina

Liquid wastes from Graniteville, Warrenville, and Vaucluse are discharged to Horse Creek at a point where the natural low flow is approximately 6 cfs. The stream flow required after secondary treatment is 28.3 cfs, 27.4 cfs, and 23.4 cfs in 1960, 1975, and 2000 respectively. The storage required on Horse Creek will be 7,680, 7,100 and 5,600 acre-feet in 1960, 1975, and 2000 respectively.

Hartwell Reservoir

Liquid wastes from Clemson, Clemson College, LaFrance, and several smaller towns are discharged directly to Hartwell Reservoir. Secondary treatment for all wastes has been recommended as a desirable minimum for reservoirs used for recreation purposes, but no attempt has been made to determine augmentation requirements. Alleviation of pollution in large reservoirs would be better accomplished by wastes dispersion through properly designed outfalls and/or a high degree of treatment.

Summary of Augmentation Needs

The areas in the Savannah Basin where storage for low flow augmentation is needed are shown below:

TABLE P-10
RESERVOIR STORAGE NEEDS
SAVANNAH BASIN

Location	Storage Acre-Feet 1960	1975	2000
Commerce	not economically feasible		
Elberton	not economically feasible		
Hartwell	diversion from Hartwell Reservoir		
Richmond County	not economically feasible		
Rincon	not economically feasible		
Sylvania	insufficient drainage area		
Thomson	not economically feasible		
Aiken	insufficient drainage area		
Anderson	60	1560	1980
Belton	insufficient drainage area		
Graniteville	7680	7100	5600
Greenwood	insufficient drainage area		
McCormick	not economically feasible		
Seneca	not economically feasible		

ANNUAL COSTS AND BENEFITS

FINANCING

Municipalities can finance sewage works construction by general obligation bonds, revenue bonds, special assessments, or some combination of these methods. The Georgia law permits the issuance of general obligation bonds to be repaid within 30 years, up to a maximum amount of 7 percent of the evaluation of taxable property within the political subdivision. The law permits an increase of this bonded indebtedness of 3 percent of the evaluation of the taxable property provided the increased indebtedness shall be repaid within a 5-year period and is approved by the General Assembly.

Georgia law authorizes the State to make grants to any county or municipality if funds are available to assist in pollution abatement projects that qualify for Federal aid under Public Law 660. The State grants are limited to 30 percent of that portion of the construction costs which qualify under the Federal aid program or

$250,000 whichever is smaller. To date, however, no grants have been made by the State.

South Carolina law permits the issuance of general obligation bonds to be repaid within 45 years, up to a maximum amount of 8 percent of the evaluation of taxable property within the political subdivision. Individual exceptions to this law have been made by the legislature.

Financial aid is available to municipalities in the form of Federal grant assistance under Public Law 660, as amended. The Federal Government will pay up to 30 percent of the estimated reasonable cost of construction of municipal sewage treatment works or $600,000, whichever is the smaller. Eligible for assistance are construction of new treatment works, improvements to existing treatment facilities, intercepting sewers, outfall sewers, pumping, and such preliminary planning necessary for construction. To date, Due West, Easley, Greenwood, and Abbeville, South Carolina, and Washington, Georgia have participated in the Federal aid program, constructing secondary sewage treatment plants and appurtenant works. Applications have been received and approved and Federal grant offers have been made to Anderson, Clemson College, Easley, Edgefield, Greenwood, Pendleton, and Seneca in South Carolina, and Toccoa, Harlem, and the Gracewood School for Mental Defectives in Georgia.

Industries will undoubtedly finance their pollution abatement facilities with private capital by the most economical method available to them at the time of construction.

ANNUAL COSTS FOR 1960

The annual cost of pollution abatement by municipalities and industries in the Basin in 1960 is estimated to be $2,748,730. This includes the annual equivalent capital cost of existing facilities in 1960, annual replacement, and operation and maintenance cost of existing facilities. A breakdown of the total annual cost is shown below:

	Mun.	Ind.
Annual equivalent capital cost	$1,500,000	$ 94,465
Annual replacement cost	50,000	15,015
Annual operation and maintenance cost	493,000	596,250
Total annual cost (1960)	$2,043,000	$705,730

The total capital outlay required to improve existing pollution abatement facilities to meet the 1960 needs is estimated to be $27,897,000 for 57 municipalities and $9,495,000 for 36 industries. These costs are shown by Tables P-3 and P-4.

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ANNUAL COSTS BY 1975

The total capital outlay required for additional pollution abatement facilities needed by 1975, after 1960 needs have been met, is estimated to be $14,574,000 for 47 municipalities and $4,468,000 for 29 industries. These costs are shown by Tables P-7 and P-8.

The annual cost of pollution abatement by municipalities and industries by 1975 is estimated to be $6,522,410. This includes the annual equivalent capital cost of: (1) existing facilities in 1960, (2) facilities recommended to meet 1960 needs, and (3) facilities recommended to meet 1975 needs. The replacement cost is based on the total investment by 1975 and the operation and maintenance cost is based on existing and recommended facilities as of 1975. A breakdown of the annual cost is given below:

	Mun.	Ind.
Annual equivalent capital cost	$3,510,700	$ 772,510
Annual replacement cost	0	63,390
Annual operation and maintenance cost	1,293,870	881,940
Total annual cost (1975)	$4,804,570	$1,717,840

ANNUAL COSTS BY 2000

The total capital outlay required for additional pollution abatement facilities needed between 1975 and 2000 is estimated to be $31,571,000 for 49 municipalities and $6,612,000 for 32 industries. These costs are shown by Tables P-7 and P-8.

The annual cost of pollution abatement by municipalities and industries by 2000 is estimated to be $9,478,040. This includes the equivalent capital cost, the replacement cost, and the operation and maintenance cost of existing facilities and all recommended improvements for 1960, 1975, and 2000. A breakdown of total annual costs is shown below:

	Mun.	Ind.
Annual equivalent capital cost	$5,043,800	$1,093,590
Annual replacement cost	0	103,030
Annual operation and maintenance cost	1,848,450	1,289,170
Total annual cost (2000)	$6,992,250	$2,485,790

BENEFITS

It is recognized that pollution control results in benefits to public health and to those economic activities associated with the use of water of improved quality. However, because there is no established market value for water as a commodity sold in a competitive market, monetary benefits from improvements in quality of water now used or anticipated to be used in the future, from public or private supplies, in the Savannah Basin are indeterminate.

While pollution abatement does enhance fishing and recreational opportunities, protect health, preserve and improve property and aesthetic values, and assure future utility of water resources, these values are confined largely to the intangible or social realm.

Ordinarily for those functions for which no market values are clearly established their values may in some cases be derived or estimated indirectly from prices established in the market for similar or analagous effects or may be derived from the most economical cost of producing similar effects by an alternative means. In the case of pollution abatement, however, there are no established prices for similar effects since no analagous effect exists. Neither are there alternative means of providing similar effects since, in most cases, the most likely, least cost means of attaining the desired effects is used. Therefore, lacking adequate methodology for assessing social values, benefits from pollution abatement must, for the time being, be considered as intangible. In the absence of established or synthetic market values, since the benefits from pollution abatement are real although intangible, it is considered that benefits accruing from pollution control by conventional treatment processes are at least equal to the cost of providing the facilities.

Since knowledge of society's future needs is less complete and accurate than information of present requirements, there could well be a tendency to adopt a water quality standard that is at times to high. Such has not been the case in the development of costs in this memorandum, however, because only minimum requirements or needs have been expanded into the future.

SUMMARY

1960

At the present time, there are 62 municipalities (which includes 11 institutions) and 99 industries which discharge wastes, treated and untreated, into the surface waters of the Savannah Basin.

The total volume of municipal and industrial wastes discharged to the waters of the Basin is estimated to be 176.12 mgd and the total PE of these wastes is estimated to be 2,467,610 before treatment and 2,180,180 after treatment.

The existing (1960) total annual cost of pollution abatement by municipalities and industries in the Basin is estimated to be $2,748,730.

1975

By 1975, 68 municipalities and 60 industries are expected to discharge wastes to the surface waters of the Savannah Basin. The total PE of these wastes is estimated to be 3,042,700 before treatment and 1,449,400 after recommended treatment.

Reservoir storage for low flow augmentation will be needed in 2 areas in the Basin by 1975. In 5 other areas, waste waters will need to be diverted to nearby streams which have sufficient flow to adequately assimilate the wastes. In 7 areas, the size and length of the receiving streams is such that flow augmentation during periods of low flow would not be economically feasible and thus severely polluted conditions are expected to exist for short distances in those streams.

The total annual cost of pollution abatement by municipalities and industries by 1975 is estimated to be $6,522,410. This total includes the cost of existing facilities and those needed to meet existing (1960) and projected 1975 needs.

2000

By 2000, 68 municipalities and 62 industries are expected to discharge wastes to the surface waters of the Savannah Basin. The total PE of these wastes is estimated to be 3,838,400 before treatment and 1,927,000 after recommended treatment.

Reservoir storage for low flow augmentation will be needed in two areas in the Basin by 2000. As in 1975, waste waters will need to be diverted to other streams in 5 areas and in 7 areas low flow augmentation will not be economically feasible and thus polluted conditions are expected to exist in localized areas.

The total annual cost of pollution abatement by municipalities and industries by 2000 is estimated to be $9,478,040. This value includes the cost of existing facilities, and those needed to meet existing (1960) and projected 1975 and 2000 needs.

PH-1

PUBLIC HEALTH

INTRODUCTION

This Technical Memorandum is written with the limitation that field data were not available for all phases. Presentation of data in the subject areas of Vector Control and Solid Wastes is based upon published material and on field studies done by the Communicable Disease Center of the Public Health Service. The information is general and portions cannot be applied specifically to the Basin, but their presentation will serve as a guide to the solution of Basin problems as well as broader State and Regional problems.

For purposes of this Public Health Technical Memorandum all of Chatham County and the city of Savannah are considered to be in the Savannah Basin.

VECTOR CONTROL

INTRODUCTION

Vector problems and control efforts in this Basin may be subdivided into two segments -- urban and rural. In this study selected towns in the Basin of over 1,000 population were grouped into the urban setting. Many Georgia towns have modest mosquito larviciding and adulticiding programs. Most South Carolina counties have vector control programs centered in the towns which are primarily concerned with the control of mosquitoes, and secondarily with flies, rats, and other vectors. These programs are administered by the county health departments. In the rural areas, vector problems (except for 5 to 10 mile range fresh-water flood mosquitoes) are mostly associated with the activities of individuals who solve them on an individual basis. Exceptions to this occur in residual house spraying work in the following South Carolina counties: Pickens, Anderson, McCormick, Abbeville, Edgefield, Aiken, Allendale, Hampton, and Beaufort.

For long-range planning concerning land and water uses, emphasis has been given to recommendations that would result in an environment by the years 1975 and 2000 that would require only a minimum of repetitive pesticide application. This will not only minimize the cost of vector control programs to the public but will make them more effective.

EXISTING VECTOR PROBLEMS

Eastern encephalitis ("sleeping sickness") has caused serious losses among horses in the Basin. Mosquito vectors of this highly fatal human and horse disease are most prevalent in the swamps and marshes located close to and along the coast.

Primary local malaria transmission has been at extremely low levels in recent years. The number of malaria mosquitoes, Anopheles quadrimaculatus, remains about the same in this Basin as in years when malaria was prevalent. Therefore, as long as travelers are bringing malaria parasites back to this country from malarious areas of the earth, there will remain a danger of malaria transmission in this Basin. Thus, the continuance of mosquito control efforts coupled with surveillance will be required for many years. Fresh-water pools and ponds with vegetation are favorite breeding places for malaria mosquitoes.

Typhus fever (flea-borne) was a severe problem in Georgia and South Carolina during the 1930's and 1940's. During recent years improved sanitation practices (limiting the domestic rat's food and harborage) and the use of newer rat poisons and flea insecticides have reduced transmission of this disease to low levels. In 1959, only eight cases of typhus fever were reported in Georgia. The pest control industry has played an important role in halting typhus transmission in the urban setting. Most of the remaining transmission of this disease appears to take place in rural areas.

There is considerable transmission of various enteric infections by houseflies. Determination of precise case rates is difficult because of many factors, including poor reporting, difficulties of diagnosis, and many patients not seeking medical help.

Rocky Mountain spotted fever occurs occasionally in Georgia and South Carolina. Increased use of recreational areas and construction of suburban housing areas appear to increase the possibility of American dog ticks transmitting Rocky Mountain spotted fever to humans. It is noteworthy that in eastern United States the incidence of this disease has been highest among vacationists and picnickers, particularly among women and children.

Conjunctivitis (pick eye), a common disease of younger children, is a considerable problem in the non-coastal portions of this Basin and is confined largely to rural areas. One mode of transmission of this disease is by eye gnats (Hippelates). Oviposition of these insects occurs in freshly cultivated or otherwise disturbed soil.

The coastal area of this Basin with extensive tidal marshlands is notorious for biting insects. Salt-marsh mosquitoes occur in large numbers and cause great annoyance to residents and visitors. At times these insects occur in such overwhelming numbers that outdoor activities during the day or night are practically impossible. Large broods of salt-marsh mosquitoes frequently occur following unusually high tides or heavy rains.

Fresh-water swamps, marshes, and low-lying areas that receive floodwater are also important sources of mosquitoes.

Sand flies, deer flies, horseflies and other biting insects occasionally occur in great numbers causing extreme annoyance to residents and visitors.

Throughout the Basin, numerous small patches of alligatorweed and water hyacinths are found in the small ditches and drainage creeks. Both of these obnoxious weeds were introduced to the United States from tropical areas and are spreading throughout the Basin. Profuse growths of weeds tend to clog drainage ditches, canals, ponds, etc., creating conditions favorable for malaria mosquitoes. There are Federal programs which plan for the eradication of obnoxious weeds.

In urban areas, vector problems are frequently associated with improper disposal of sewage. Severe Culex mosquito problems have developed where communities discharge improperly treated sewage into swampy or impounded areas near town. In about 15 percent of the towns studied, overflowing septic tanks were a problem, leaving ideal places for the breeding of Culex mosquitoes. Wastes stabilization ponds are beginning to appear in the Basin and could cause mosquito breeding problems unless they are properly operated and maintained free from weeds. There are now three wastes stabilization ponds in Savannah successfully handling sewage from outlying subdivisions, none of which have had significant mosquito breeding.

A housefly problem has occurred the past two summers in a large suburban area near Savannah's overloaded Bacon Park sewage treatment plant. Housefly breeding of great magnitude has occurred in undigested sludge applied to the sludge drying beds. During the winter of 1960 - 1961, a sand removal chamber had been added and sand removed from the digester tanks. This may improve digester operation to produce only digested sludge and thus reduce the fly problem.

Housefly, rodent, and roach problems in cities and rural areas are usually associated with inadequate refuse storage collection and disposal practices. In addition, many business and residential lots are littered with garbage, tin cans, bottles, tires, worthless lumber, and other discarded junk. Refuse collection schedules are usually adequate. Daily service in business areas and twice weekly service in residential areas are needed for effective vector control. The city of Savannah has recently joined others in the trend toward a new type of refuse collecting system featuring large insect-, rodent-, and water-proof containers which can be emptied on the spot mechanically into a large compactor truck. Savannah has purchased 357 such storage units and is placing them in business areas, schools, public housing areas, and certain apartment blocks. Refuse disposal practices are deficient in other portions of the Basin. Illegal dumping along county roads is a problem as noted by several directors of sanitation.

About 25 percent of the homes in the urban areas do not now meet minimum sanitation standards and thus have associated fly, rat, and mosquito problems. Local directors of sanitation are aware of vector problems and the need for correctional programs in substandard housing. Several rat bite cases have occurred recently in substandard housing in Stephens County. Savannah and Augusta have excellent minimum housing programs administered by their County Health Departments. Approximately 10 percent of the estimated 13,000 substandard housing units in Savannah have been brought up to standard. In 3 years of program operation here, 279 housing units were razed, and 18 were vacated. In 6 years of operation, in Augusta, about 4,000 houses were brought up to standard with 8,000 more units scheduled for correction during the next few years.

The breeding of Culex mosquitoes and roaches in catch basins in several towns was noted. A large epidemic of St. Louis encephalitis was caused in Louisville, Kentucky, by Culex mosquitoes breeding in catch basins. It is costing about $1,500 per year to larvicide the 2,100 catch basins in Savannah which breed mosquitoes at certain times of the year. Another 1,100 catch basins in the newer sections do not hold water and thus do not provide mosquito breeding environment.

Cat fleas, dog fleas, and and dog ticks are a problem in many cities in this Basin. The problem appears to be increasing because of increasing populations of dogs - both roving and penned.

Dog pens were mentioned by several directors of sanitation as being an increasing problem with respect to neighborhood noise and odor nuisance, fly attraction and breeding, and rodent problems.

The U. S. Army Corps of Engineers drainage activities have created a considerable salt-marsh mosquito breeding problem along the Savannah, Georgia and Charleston, South Carolina portions of the Atlantic Coast. In places, a great portion of the spoil material dredged from the bottom of the intracoastal water and harbor navigation channels is a clayish muck in which large cracks form when the material dries. These large cracks form an ideal mosquito breeding place, especially for the severe biting salt-marsh mosquito, Aedes sollicitans.

A number of ditches in the Basin were constructed with continuous spoil banks of both sides. This method of spoil placement results in another mosquito breeding problembecause of the lateral blocking of surface water.

In rural areas, the utilization and management of water gives rise to a variety of insect vector problems.

Inadequacies in general drainage construction and maintenance contribute to mosquito breeding in the Basin. Most small creeks, canals, and drainage ditches receive little or no maintenance. Frequently, individual farmers and towns are not able to construct the small drainage ditches because of the lack of or clogged large main drainage canals in the county system.

Chatham County, Georgia, uses about 70 prisoners for general hand drainage work in a very effective manner.

Recent increased construction rates of large impoundments are viewed with concern by State departments of health with regard to possible encephalitis transmission. Of particular concern are large, shallow water reservoirs in which aquatic vegetation and mosquitoes could grow profusely.

There are numerous farm ponds in this Basin and many more are being constructed each year. Mosquito breeding in these farm ponds has not been serious due to good construction and operating procedures. The only inadequacy noted was in upstream shallow water portions, usually uncleared, and where weeds are permitted to grow. Several local health department directors of sanitation stated that many farm ponds in their areas were constructed in low swampy areas that formerly bred many fresh-water flood mosquitoes and that the construction of farm ponds has greatly reduced mosquito annoyance in the area by changing mosquitoes from fresh-water flood species to permanent fresh-water species.

The use of water for irrigation (sprinkler type) is increasing in the Basin. It is used principally during periods of dry weather for such crops as tobacco, corn, and for pastures. No significant mosquito problems have developed from application of irrigation water to the fields.

Local sanitarians report the existence of several wastefully flowing artesian wells in this Basin. Known mosquito production associated with artesian wells has not been heavy.

Vector problems associated with land resource activities include those related to the production of livestock and poultry.

Hog parlors are beginning to spring up all over the southeastern States and several have appeared in this Basin. A common practice is to wash accumulations from the concrete floors of the parlors to an open septic tank. The overflow often discharges to the nearest low, swampy area. This method of disposal frequently causes extensive housefly breeding. Hog parlors may have considerable rat infestations.

Chicken "factories" are also found in the southeast and there are large numbers in this Basin. In egg factories, the birds are usually kept in small elevated cages, beneath which cones of manure accumulate on dirt floors. Major fly and rodent problems develop where there is poor housekeeping. In another type of egg and chicken factory, the chickens are kept on a deep bed of wood shavings which is removed only occasionally. Waste chicken feed from a power conveyor and water drip plus the accumulation of manure creates a favorable breeding place for flies. Agricultural authorities are now strongly recommending deep pits for the disposing of dead chickens and thus are reducing a source of fly breeding attraction.

Solid waste material (principally manure) on farms is being produced in increasing amounts and required frequent spreading on fields for sanitary disposal without creating a fly problem. The spreading of such wastes on fields at frequent intervals may be difficult due to crop growing and manpower requirements.

Dairy barn liquid wastes when allowed to discharge into nearby pastures sometimes give rise to mosquito problems.

Many farms in the area have rat populations which eat an estimated $5.00 worth of food per year per rat and damage stored farm products at much greater monetary rates.

Only a few fire ant mounds were noted in the Basin. Fire ant stings are very severe, and have caused a few human deaths. The mounds are not only unsightly but are detrimental to agricultural operations.

STATUS OF EXISTING PROGRAMS

There is no State-wide enabling legislation for the establishment of mosquito or other vector control districts in Georgia or South Carolina.

Both Georgia and South Carolina have specific health regulations pertaining to the impounding of water. Permits are issued for farm ponds constructed under state board of health regulations.

The Florida State Board of Health's Entomological Research Center at Vero Beach, Florida is working on the control of insects affecting human health. Research on vector control is also being conducted at two Federal Research stations in the southeast -- the Orlando, Florida Laboratory of the Entomology Research Division (USDA) and the Technical Development Laboratories of the Communicable Disease Center (PHS), Savannah, Georgia. In Pensacola, Florida, the Public Health Service, in cooperation with the State and local health departments, is attempting to eradicate the yellow fever mosquito, *Aedes aegypti*. Now in its third year of operation, the project is making excellent progress toward the eradication goal. Public education, environmental sanitation, and DDT residual premises spraying are methods being utilized.

Health agencies provide technical assistance to the construction and operating agencies in planning and carrying out vector control operations. Local sanitarians give technical advice and assistance to local communities and to individuals.

Present vector control programs in the South Carolina portion of the Basin consist of 12 county-wide vector control programs centered in health departments. Operations are centered on adulticiding for the control of mosquitoes and on the residual spraying of homes and outbuildings in selected rural areas where malaria transmission would most likely occur. In addition, there is mosquito larviciding and permanent mosquito control work in various towns. County health departments conduct or assist with rodent control programs both in towns and in rural sections. The South Carolina State Board of Health has an annual fund of $105,000, most of which is used to purchase insecticides. The State furnishes insecticides where the local governmental units will furnish men and equipment for application. In addition to insecticides, the State loans 38 trucks and gives technical consultation and assistance (three full-time State vector workers). Rodenticides are purchased in large lots by the State and sold at cost to local governmental units. It would be advantageous in the future if more State aid money could be made available to help stimulate local permanent mosquito control measures.

In the Georgia portion of the Basin, vector control programs consist of several city mosquito control programs and one mosquito control commission. Most of the city mosquito control activities are given over to adulticiding measures.

The Chatham County Commission owns and operates 3 draglines, 6 fogging trucks, 1 airplane, and 4 larviciding vehicles in the Ogeechee and Savannah Basins. The draglines and a crew of 8 prisoners construct and maintain water management ditches. So far, water management ditches have been constructed in 1,800 acres of salt marsh and it is estimated that 5,000 acres of salt-marsh breeding area remain to be ditched. Only about 100 acres of fresh-water mosquito area have been ditched and it is estimated that 3,000 acres should be ditched (mostly pasture land). Pasture drainage ditches will not be very satisfactory until the main county canal system is expanded and improved. This latter type of canal construction at present appears beyond the financial resources of the Mosquito Commission.

The salt-marsh ditches are constructed for management of water in the upper portions of the marshes. Over 95 percent of the salt-marshes on the coast are covered with daily tide water and thus do not breed salt-marsh mosquitoes and will not require water management ditches. Present knowledge indicates that the construction of upland water management ditches enhances fish propagation and has little or no deleterious effect on water fowl. This ditching is usually a minimum of 8 to 9 feet wide and at least 2 feet deeper than mean low water. Such ditches abound in minnows and other fish. Care is taken not to drain large permanent bodies of water in the marshes which encourage duck populations and which do not breed salt-marsh mosquitoes or sand flies.

The Chatham County Commission will construct impoundments if favorable locations are found. The use of impoundments is the one permanent mosquito control method that reduces both sand fly breeding and mosquito breeding.

The Chatham County Mosquito Control Commission has pioneered the routine use of the new paris green pellet formulation in the control of mosquito larvae using both aerial and ground applications. Paris green pellets are very specific in their killing effect; control of mosquitoes is excellent, and no toxic effect on crops, fish, wildlife, cattle, etc. has been noted. Paris green pellets are used extensively and routinely at Fort Pulaski National Monument where trained naturalists have observed no side toxic effects.

Extensive studies on rat problems in Grady, Thomas, Brooks and Decatur Counties (Georgia) have been made in recent years by the Public Health Service. These studies indicate the many economic and disease prevention values of county-wide rodent control programs.

Several military bases are located in this Basin and all of them have modest vector control programs. The Savannah River Plant of the U. S. Atomic Energy Commission has a modest program for the control of mosquitoes, eye gnats, and rodents.

There are two large water impoundments in the Basin for power and flood control purposes, operated by the U. S. Army Corps of Engineers.

Clark Hill Reservoir was created in 1952 and covers about 70,000 acres and 1,060 miles of shoreline at maximum power pool. Designed drawdown for power is 25 feet. The mosquito control program by the Corps of Engineers includes contract aerial larviciding service supplemented by minor drainage and shoreline maintenance work. Formerly, DDT larvicide was applied each year by airplane at dosage rates 0.08 to 0.20 pounds of actual DDT per acre per application. Usually there were 15 to 20 applications per year in certain breeding areas. DDT resistance in _Anopheles quadrimaculatus_ developed in one locality in the late summer of 1959. A switch to malathion was made in 1960. The development of this DDT resistance suggests that this program is improperly balanced and that in the future more emphasis should be places on permanent control measures. Due to the increasing threat of encephalitis, light traps and landing rate stations should be operated in order to adequately sample adult populations of all species of mosquitoes.

Hartwell Reservoir will be very similar in size and shape to Clark Hill. The maximum power pool drawdown of 35 feet will completely empty upstream portions of the Tugaloo River Reservoir during the late summer, possibly creating mosquito and other vector problems. A low level dam located near Sugar Creek is now being considered to remedy this defect. The Corps of Engineers will operate a mosquito control program at Hartwell which will be very similar to the Clark Hill program.

The Georgia Power Company operates several smaller power impoundments at the very upper end of the Savannah River Basin. Because of the relative absence of shallow water, few mosquito problems have developed.

EXISTING NEEDS

There is a need for more emphasis to be given to larviciding and permanent control measures. Each county in the Basin needs at least one dragline for mosquito work. Each city in the Basin should have from one to several year-round mosquito control workers who would inspect for larvae during the mosquito season, apply larvicides to mosquito breeding areas, operate adulticiding machines occasionally when large mosquito infestations occur, and do maintenance and minor ditch construction during winter months.

Legislative and regulatory needs include:

1. State enabling legislation permitting the establishment of tax-supported vector control districts in any county of Georgia or South Carolina.

2. Regulations to require the control of wasteful flow from artesian wells.

Needs pertaining to surveillance and technical assistance include:

1. Extensive surveys of vector disease occurrence and vector problems.

2. Increased training of local health department personnel in vector control intelligence.

3. Expansion of entomological and engineering consultative services to agencies, industries, and individuals concerned with water and related land resource development.

Some of the major research needs include:

1. Development of better permanent control techniques in salt marches that will control mosquitoes, sand flies, and other vectors and at the same time be helpful to other interests, such as wildlife conservation.

2. Development of better equipment and methods for constructing and maintaining water management ditches.

3. Development of new agricultural and industrial uses for idle coastal land.

4. Improved methods for the sanitary handling of manure and other wastes on livestock and poultry farms including the possible use of stabilization ponds for disposal of wastes and for irrigation and fertilization.

5. Improved design for catch basins so that they do not hold water.

6. Development of new or modified chemical formulations which would overcome insecticide resistance problems and present less danger to water supplies.

7. Development of improved equipment and application techniques for chemical control of vectors in urban and rural areas.

Vector control program needs include:

1. Establishment of a mosquito control district in Beaufort County, South Carolina. This district would need about 3 draglines for permanent control work.

2. The intensification of mosquito control programs on Clark Hill Reservoir and increase in budget for mosquito control activities at Hartwell Reservoir.

3. The development of county-wide water management systems and programs.

4. Extension of the use of sanitary landfills to all towns and counties in the Basin. Many depressions and low lands exist in the Basin that could be filled profitably using the sanitary landfill method.

5. Increased implementation of Federal programs by State and local interests to eradicate infestations of alligatorweed and water hyacinths and other obnoxious weeds in the Basin.

State aid to county health departments in South Carolina has proven very successful, and includes the purchase of insecticides, trucks, and technical consultation and assistance. More State aid funds for permanent control measures are needed. Similar State aid funds and technical assistance are needed in Georgia.

In order that vector control programs be compatible with multipurpose functions, it is essential that there be coordination between all agencies concerned.

POTENTIAL PROBLEMS AND SOLUTIONS

Based on present knowledge, the one vector problem that appears to be on the rise and could be a significant one in the Basin is mosquito-borne encephalitis -- both the Eastern and St. Louis strains. Eastern encephalitis has caused serious losses among horses in the Basin. Sooner or later it could cause epidemics among man, as occurred in New Jersey in 1959 (this constituted New Jersey's first confirmed human cases, even though it had killed horses there for at least 50 years). The Eastern disease occurs principally in areas with vast fresh-water swamps and salt marshes (Coastal Plain).

St. Louis encephalitis -- a human disease -- is not known to have occurred in the Basin, but it has recently been reported in Pinellas County, Florida. This disease presents a threat to communities in the Basin that allow uncontrolled production of Culex mosquitoes.

On the basis of current knowledge concerning mosquito-borne encephalitis, the only feasible approach to control of the disease is a program of prevention -- mosquito control for the community (or population groups) and protection against mosquito bites for the individual.

Increases in transmission of enteric infections by houseflies could increase due to changes in agricultural practices together with further "suburbia" development.

COSTS AND BENEFITS

The principal benefit of any well-organized vector control program is to provide adequate safeguards to the public health. This includes freedom of disease and infirmity which is difficult to evaluate in dollars. Recent research studies have shown, especially in small children, that permanent brain and motor damage frequently result from cases of mosquito-borne encephalitis. The prevention of just one death or case of permanent damage would amply justify the amount of money proposed for vector control work in any one of the towns or counties in this Basin.

Additional benefits of vector control programs would be as acceleration of development and use of waterfront land. It is common knowledge that excessive numbers of salt-marsh mosquitoes, sand flies, houseflies, and other vectors on such land are an impediment to industrial plants, subdivision developments, and recreational areas. Wilmington Island, Chatham County, Georgia, is now experiencing a great upsurge in construction as a result of the successful mosquito control commission program.

Another benefit would be to provide economic safeguards, particularly with reference to tourism or resort areas. This is exemplified by the 1959 outbreak of Eastern encephalitis in New Jersey. Although this outbreak involved only 33 human cases with 21 deaths during a 2-month period, it was estimated that the episode caused a loss to Atlantic City hotels of $2,000,000.

The estimated costs of needed vector control programs are included in Table PH-1. Studies in the Chatham County, Georgia area have shown that the total cost of the mosquito control program is being substantially balanced by reduced costs to families in the purchase of household sprays, aerosol bombs, and repellents.

The estimated costs of rural rodent control programs will be balanced several times by savings from rodent damage to stored farm products.

TABLE PH-1
VECTOR PROBLEMS AND PROGRAMS
SAVANNAH BASIN

Location and 1960 Population	Vector Problem Degree			Approximate Annual Cost of Vector Control Program*		Refuse Disposal Method	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
GEORGIA									
Augusta 70,626		M R	F T	None	$30,000	Sanitary landfill	Severe	Severe	Sanitary landfill is part of county SLF system.
Elberton 2,107	R	F T	M	$ 400	10,000	Burning Modified landfill	Moderate	Light	Increase last year in woods ticks attacking people
Fort Gordon 15,604		M	F R T	about 15,000	15,000	Sanitary landfill	Light	Light	
Harlem 1,423			M F R T	None	500	No refuse system	Light	Light	
Hartwell 4,599		F R T	M	1,500	3,000	Open burning dump	Light	Light	

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TABLE PH-1 (CONT'D)

Location and 1960 Population	Vector Problem Degree			Approximate Annual Cost of Vector Control Program*		Refuse Disposal Method	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
Royston 2,333		F R	M T	None	$1,000	Open burning dump	Light	Light	Town is planning a future sanitary landfill
Savannah 149,245	M	F	R T	See Chatham County		Sanitary landfill	Severe	Moderate	
Sylvania 3,469		R	M F T	$3,000	12,000	Open dump	Light	Moderate	
Thomson 4,522		M	F R T	None	5,000	Sanitary landfill	Severe	Light	
Toccoa 7,303		M F R	T	None	10,000	Burning modified landfill	Light	Moderate	Some mosquito problems associated with untreated sewage discharges
Washington 4,440		M	F R T	2,000	4,000	Open burning dump	Light	Light	
Waynesboro 5,359		F R	M T	3,000	10,000	Open dump	Moderate	Light	New sewage treatment plant has greatly reduced mosquito problem

TABLE PH-1 (CONT'D)

Location and 1960 Population	Vector Problem Degree			Approximate Annual Cost of Vector Control Program*		Refuse Disposal Method	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
Chatham County 188,299	M	F	R T	$140,000	$140,000	Open dumping			Needs county-wide system of sanitary landfills
Richmond County									Has county-wide system of sanitary landfills
Stephens County									Has county refuse disposal site
Clark Hill Reservoir		M	F R T	30,000	50,000				Filling and deepening projects in shallow water areas needed
Hartwell Reservoir (New)				20,000 **	50,000				Initial flooding during 1961
SOUTH CAROLINA									
Abbeville 5,436			M F R T	See Abbeville Co.		Sanitary landfill	Light	Light	
Aiken 11,243			M F R T	See Aiken Co.		Sanitary landfill	Light	Light	

TABLE PH-1 (CONT'D)

Location and 1960 Population	Vector Problem Degree			Approximate Annual Cost of Vector Control Program*		Refuse Disposal Method	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
Allendale 3,114		M F R	T	See Allendale Co.		Open dump	Light	Moderate	
Anderson 41,316		M F	R T	See Anderson Co.		Sanitary landfill	Light	Moderate	Mosquito problems in open ditches containing sewage
Calhoun Falls 2,575	M	F R	T	See Abbeville Co.		Open dump	Moderate	Severe	Mosquito problems in open ditches & creeks containing industrial wastes
Central 1,473			M F R T	See Pickens Co.		Open dump	Light	Light	
Clemson 4,000		M	F R T	See Pickens Co.		Open dump	Moderate	Light	
Due West 1,166		M	F R T	See Abbeville Co.		Open dump	Moderate	Light	
Edgefield 2,876		M	F R T	See Edgefield Co.		Open dump	Moderate	Light	
Estill 1,865		M F R	T	See Hampton Co.		Open dump	Moderate	Moderate	

TABLE PH-1 (CONT'D)

Location and 1960 Population	Vector Problem Degree			Approximate Annual Cost of Vector Control Program*		Refuse Disposal Method	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
Greenwood 16,644		M F R	T	See Greenwood Co.		Sanitary landfill	Light	Light	Lack of adequate ditch maintenance is causing mosquito problems
Horse Creek Valley about 20,000	M	F R	T	See Aiken County		Open dumps	Severe	Severe	Large contiguous population area which includes towns of Graniteville, Warrenville Langley, Bath and Clearwater
Iva 1,357			M F R T	See Anderson Co.		Open dump	Light	Light	
Jackson 1,740			F M R T	See Aiken Co.		Open dump	Light	Light	
Liberty 2,657			M F R T	See Pickens Co.		Sanitary landfill	Light	Light	
McCormick 1,998	M	F R	T	See McCormick Co.		Open dump	Moderate	Moderate	Town needs a mosquito larviciding program

TABLE PH-1 (CONT'D)

Location and 1960 Population 1960	Vector Problem Degree 1	Vector Problem Degree 2	Vector Problem Degree 3	Approximate Annual Cost of Vector Control Program* Present	Approximate Annual Cost of Vector Control Program* Needed	Refuse Disposal Method	Storm Water Drainage	Open Water with Sewage Problems	Comments
North Augusta 10,348		R	M F T	See Aiken Co.		Modified landfill	Light	Light	
Seneca 5,227		F	M R T	See Oconee Co.		Open dump	Light	Light	
U.S. Atomic Energy Commission Savannah River Plant			M F R T	$6,000	$6,000	Sanitary landfill	Light	Light	Occasionally severe eye gnat annoyance occurs
Walhalla 3,431		M F	R T	See Oconee County		Sanitary landfill	Light	Light	
Westminster 2,413			M F R T	See Oconee County		Open dump	Light	Light	
Oconee County				10,000	10,000	Program consists of mosquito adulticiding in larger towns.			
Pickens County				5,000	8,000	Program consists of mosquito adulticiding in the larger towns and selected residual spraying of homes in rural areas.			
Anderson County				12,000	12,000	Same as Pickens County			
McCormick Co.) Abbeville Co.) Joint Program				6,000	11,000	Same as Pickens County			
Greenwood County				9,000	12,000	Same as Oconee County			

TABLE PH-1 (CONT'D)

Location and 1960 Population	Vector Problem Degree			Approximate Annual Cost of Vector Control Program*		Refuse Disposal Method	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
Edgefield County				$1,000	$4,000	Same as Pickens County			
Aiken County				8,000	20,000	Same as Pickens County			There is county-wide refuse collection & disposal system
Allendale County				3,000	6,000	Same as Pickens County			
Hampton County				3,000	6,000	Same as Pickens County			
Jasper County				500	3,000	Same as Oconee County			
Beaufort County				5,000	100,000	Same as Pickens County			

*Costs of refuse collection and disposal are not included in this table.
**Amount provided for 1961

1 - Severe	M - Mosquitoes
2 - Moderate	F - Flies
3 - Light	R - Rats
	T - Ticks

(5/1/62)

AIR POLLUTION

PROBLEMS

The Savannah Basin has 18 known chief sources of industrial air pollution in Georgia, located in four counties, Burke, Chatham, Elbert and Richmond. Of the 18 industries, 5 are pulp and paper mills, 8 are chemical and fertilizer plants, 4 are kaolin and brick processing plants, and the other is the granite quarry and processing operation in Elbert County.

These industries release dust, gases, smoke, fly ash, odors, and particulate matter to the atmosphere and cause discomfort to the general population. Municipal air pollution problems are also associated with the burning of garbage and refuse on city dumps, the method principally used in smaller communities.

There can be found some kind of air pollution problem in most every urban center in the Basin. Pulp and paper mills and the chemical industries are of chief importance and should be considered first in abatement programs.

STATUS OF EXISTING PROGRAMS

Public Law 159-84th Congress, and its amendments, provide for "Federal technical services and financial aid to State and local government air pollution control agencies and other public or private agencies and institutions in the formulation and execution of their air pollution abatement research programs." The Surgeon General may (1) encourage cooperative activities by State and local governments for the prevention and abatement of air pollution, (2) collect and disseminate information relating to air pollution and the prevention and abatement thereof, (3) conduct investigations and research and make surveys, and (4) prepare and publish reports and make appropriate recommendations with regard to the control of air pollution.

National Air Network Sampling Stations are located at Augusta and Savannah. Others operate just outside the Basin at Macon, Atlanta, Columbia and Charleston. The Georgia and South Carolina departments of health cooperate with the Public Health Service in this program.

The Industrial Hygiene Service, Georgia Department of Public Health, has maintained records of complaints on industrial air pollution problems since 1945. Control measures used have consisted of investigation of these complaints, and where justified, discussion with the offending parties to work out a solution to the problem.

Work is underway by the Public Health Service and the Georgia Department of Public Health on a State-wide survey to locate all sources of air pollution in Georgia. The Survey began January 1, 1961, and as of April 1962 a preliminary draft had been prepared.

South Carolina does not have an air pollution program. In 1960 the legislature appointed a committee to make a continuous study of problems created by the post World War II industrial expansion, including air pollution. It is expected that from this committee report will come recommendations for the enactment of enabling legislation to provide for a suitable air pollution program. There are State health regulations that prohibit the discharge to the atmosphere of fumes which are offensive or dangerous to the health of human beings and to plant life.

EXISTING NEEDS

Georgia and South Carolina should enact legislation to provide facilities for a broad program to control and supress air pollution. The pollution to be controlled includes but is not limited to the emission of smoke, particulate matter, soot, cinders, ashes, toxic and radioactive substances, fumes, vapor, gases, odors and dusts which constitute a nuisance or a danger to public health, plant life, or impairs the public comfort and convenience.

In the September 1959 administrative report of the Georgia Department of Public Health "Industrial Air Pollution Problems in Georgia", a need was expressed for a comprehensive study of air pollution problems. The survey just completed recommends the type of legislation and programs needed, and suggest the organization required to implement a control program in Georgia.

Georgia industries contributing atmospheric pollution in order of importance include the pulp and paper industry, chemical industry, rendering plants and the kaolin, talc, slate and Fullers earth industry, concentrated chiefly around Augusta and Savannah.

POTENTIAL PROBLEMS AND SOLUTIONS

It is believed that industrial development and municipal growth in the Basin will increase each year contributing increasing pollution to the atmosphere. Chemical and pulp & paper industries are the major industries expected to expand production during the period 1960-2000. Measures should be considered for correcting air pollution from municipal, commercial, and private sources. This would call for meteorological studies as an aid to zoning and planning functions, the preparation of air quality guides, and eventually the establishment of air pollution emission criteria for logical air basins.

Research has produced methods and devices to eliminate gases, smoke and particulate matter from the atmosphere. New industry should be required to install air pollution abatement devices and measures should be adopted to control present polluters of the atmosphere.

COSTS AND BENEFITS

The costs of control of air pollution cannot be evaluated since specific quantity and quality information is not available for the sources.

Benefits to be derived from air pollution abatement result from reduction in nuisances, effects on public health, and decrease in maintenance costs of buildings and of personal property. Benefits are considered to be equal to costs of air pollution control.

RADIOLOGICAL HEALTH

PROBLEMS

Radiological health problems are best determined by considering all of the following sources of radiation: air, water, milk and food, and local sources such as medical and environment. The total effect of all of these sources is not known for the Savannah Basin.

The Atomic Energy Commission operates the Savannah River Plant covering some 1200 square miles at river mile 170-180 in South Carolina. Nuclear reactors at the plant produce solid, liquid and gaseous radioactive wastes that must be disposed of to conform with established criteria for maintaining radioactivity levels. There are also numerous medical, research and industrial users of radioisotopes in the Basin, chiefly Clemson, Anderson, Augusta and Savannah, that may discharge radioactive wastes.

STATUS OF EXISTING PROGRAMS

Information on the radioactivity in the waters of the Savannah River for 1959 - 1960 is presented in Tables PH-2 and PH-3. This information was obtained from the South Carolina Water Pollution Control Authority, the Atomic Energy Commission, and the Public Health Service.

Progress reports prepared by the Health Physics Section of the E. I. DuPont DeNemours and Company, prime contractor for operation of the AEC plant, stated that "the concentration of radioactive materials found in 1958-60 in the environs of the Savannah River Plant through the release of radioactive wastes by the plant were so small that in most cases they could not be definitely distinguished from that due to natural background or to debris from nuclear weapons tests. Monitoring of domestic water supplies, fish, milk and foods in the vicinity of the plant has shown no levels of radiation that are of health significance."

Thirteen air sampling stations operated by the AEC are located within a 25-mile radius of the plant. Other air sampling stations are located at Columbia and Savannah and are a part of the PHS National Air Sampling Network. The objectives of the air sampling programs are to develop procedures for analysis, determine the amounts of specific pollutants and to evaluate the gross levels of fission products for comparison with maximum permissible levels. Table PH-4 shows the average atmospheric radioactivity at the AEC Plant and other selected stations. This information was obtained from data supplied by the AEC, South Carolina, and the Public Health Service National Air Sampling Station.

TABLE PH-2
RADIOACTIVITY IN WATER
SAVANNAH BASIN

Sampling Station	Period of Analysis	No. of Analyses	Gross Alpha (uuc/l) Avg.	Gross Alpha (uuc/l) Max.	Gross Alpha (uuc/l) Min.	Gross Beta (uuc/l) Avg.	Gross Beta (uuc/l) Max.	Gross Beta (uuc/l) Min.	Remarks
Savannah River at North Augusta, S. C.	1958-59	48	1.0(14)	8.0	0	19	464	0	Public Health Service Basic Data Station
Savannah River above Atomic Energy Power Plant	1958	*	0.4	0.9		15	50		
	1958	*	0.4	0.9		17	63		Sr^{90}avg=0.66 uuc/l
	1960	*	0.3	0.7		6	9		Sr^{90}avg=0.41 uuc/l
Savannah River below Atomic Energy Power Plant	1958	*	0.4	0.9		28	82		
	1959	*	0.4	1.4		36	140		
	1960	*	0.5	0.9		24			
Savannah River at U. S. Highway 301	1958	*	0.4	0.9		26	140		Sr^{90}avg=1.10 uuc/l
	1959	38	0.85	3.2	0.1	31	102	7	Sr^{90}avg=1.27 uuc/l
	1960	30	0.63	4.1	0.1	25	211		Sr^{90}avg=0.50 uuc/l
Savannah River at Stokes Bluff	1958	*	0.4	0.9		17	63		
	1959	*	0.4	0.9		23	97		
	1960	*	0.4	1.0		21	86		
Savannah River at Port Wentworth, Ga.	1958-59	46	1.6(10)	5.0	0	36	114	0	Public Health Service Basic Data Station

*For 1958 and 1959, annual averages shown are based on weekly grab samples except for station at Highway 301 where sampling is continuous. For 1960, annual averages are based on continuous sampling at all stations.

NOTE: Number in parenthesis shows number of analyses upon which the average was computed if different than total number of analyses.

TABLE PH-3
SUMMARY OF WATER QUALITY CHARACTERISTICS
RADIOACTIVITY IN MUNICIPAL WATER SUPPLIES
SAVANNAH BASIN

All values in micro-micro curies per liter (uuc/l)

Municipal Supply	Period of Analysis	Alpha	Beta
South Carolina			
Aiken	1951-52	5.80	6.0
	1958	2.25	7.0
	1959	2.70	9.0
	1960	1.04	6.3
Allendale	1951-52	0.30	5.0
	1958	0.45	9.0
	1959	0.20	8.0
	1960	0.18	6.1
Barnwell	1951-52	0.30	6.0
	1958	0.45	9.0
	1959	0.30	8.0
	1960	0.25	6.3
Bath	1951-52	1.90	5.0
	1958	2.70	9.0
	1959	1.40	8.0
	1960	1.90	8.3

Municipal Supply	Period of Analysis	Alpha	Beta
South Carolina (Cont'd)			
Blackville	1951-52	0.70	6.0
	1958	0.45	8.0
	1959	0.30	8.0
	1960	0.20	5.9
Clearwater	1951-52	0.30	5.0
	1958	0.45	9.0
	1959	0.20	11.0
	1960	0.33	5.0
Jackson	1951-52	--	--
	1958	3.15	10.0
	1959	3.40	8.0
	1960	3.00	7.3
Langley	1951-52	1.60	6.0
	1958	1.80	9.5
	1959	1.30	12.0
	1960	1.60	7.5

TABLE PH-3 (Cont'd)
SUMMARY OF WATER QUALITY CHARACTERISTICS
RADIOACTIVITY IN MUNICIPAL WATER SUPPLIES
SAVANNAH BASIN

All values in micro-micro curies per liter (uuc/l)

Municipal Supply	Period of Analysis	Alpha	Beta	Municipal Supply	Period of Analysis	Alpha	Beta
South Carolina (Cont'd)				Georgia			
New Ellenton	1951-52	--	--	Augusta	1951-52	0.30	5.0
	1958	0.90	11.0		1958	0.45	8.5
	1959	0.70	10.0		1959	0.20	9.0
	1960	0.60	6.1		1960	0.20	6.1
North Augusta	1951-52	2.40	6.0	Sardis	1951-52	0.30	6.8
	1958	0.63	8.0		1958	0.45	8.0
	1959	0.40	12.0		1959	0.10	8.0
	1960	0.34	6.0		1960	0.75	6.1
Williston	1951-52	0.60	6.0	Waynesboro	1951-52	0.30	7.0
	1958	0.90	8.5		1958	0.45	9.0
	1959	0.60	8.0		1959	0.20	10.0
	1960	0.77	5.7		1960	0.23	5.8

Note: Values given are annual averages of 12 monthly grab samples.

TABLE PH-4
ATMOSPHERIC RADIOACTIVITY
AVERAGE CONCENTRATION

Location	Alpha Emitters 1×10^{-15} uc/cc		Nonvolatile Beta Emitters 1×10^{-12} uc/cc		Radioiodine 1×10^{-13} uc/cc		Radioactive Particles per Cubic Meter	
	1959	1960	1959	1960	1959	1960	1959	1960
Plant Perimeter	1.0	1.2	3.8	0.17	0.9	0.4	0.03	.003
25 Mile Radius	1.0	0.9	3.0	0.12	0.5	0.4	0.02	.003
Columbia, S. C. (1)	--	--	4.1	--	--	--	--	--
Washington, D. C. (1)	--	--	3.5	--	--	--	--	--
Miami, Florida (1)	--	--	3.9	--	--	--	--	--
Maximum Permissable Concentration	40 (2)		100 (3)		1000 (2)			

(1) Data obtained by the Naval Research Laboratory, Washington, D. C.

(2) Maximum permissible concentration listed is that recommended by the National Committee on Radiation Protection for unidentified alpha emitters and radioiodine in air in the neighborhood of atomic energy plants.

(3) Maximum permissible concentration listed is that recommended by the National Committee on Radiation Protection for unidentified beta emitters in the neighborhood of an atomic energy plant. The basis of the selection of this is that the concentration of strontium-90 is small compared to its MPC.

Air-borne radioactivity material may be deposited on plants and soil as well as contaminate the air we breathe. Food and forage plants are contaminated by fall-out material attached to plant surfaces and by absorption into leaves and stems. Radioactive material may also be drawn up into plants through the root system and the soil. (See Table PH-5)

The strontium-90 and tritium content of milk produced in the Basin is of interest to Federal, State, and local health agencies. In 250 samples of milk collected during 1959 the average value for strontium-90 was less than 16 uuc/l and for tritium the average concentration was 60 uuc/l.

TABLE PH-5
VEGETATION CONTAMINATION
AVERAGE CONCENTRATIONS
(Micro-curies/gram-uc/g)

Location	Alpha Emitters* 1×10^{-7}		Nonvolatile Beta Emitters* 1×10^{-4}		Radioiodine 1×10^{-6}	
	1959	1960	1959	1960	1959	1960
Plant Perimeter	1.3	2.2	1.4	0.46	1.0	1.5
25 Mile Radius	1.6	2.7	1.9	0.38	0.8**	1.3

*Dry Weight
**Average of six-month period - July through December 1959

The determination of radioactivity in algae is of importance because of their ability to concentrate radioactive material, and of their role in the food chain of aquatic life. The average beta concentration of algae in the river as determined by the Public Health Service is shown below.

	1960	1959
Plant Site	48×10^{-6} uc/g	110×10^{-6} uc/g
Downstream	53×10^{-6} uc/g	70×10^{-6} uc/g

Bream and catfish collected from the Savannah River showed concentrations of radioactivity averaging 5 uc/g beta emitters in edible flesh from all parts of the river in 1959 and 1960.

(5/1/62)

EXISTING NEEDS

There is a need for continuous control by State and Federal agencies of radiological health hazards associated with the use of radioisotopes and the disposal of radioactive wastes in the Basin.

Georgia needs additional personnel and funds to allow expansion of their radiological air and water monitoring programs and a surveillance program to guard against contamination of milk and food supplies.

South Carolina appears to have a satisfactory program in radiological health.

POTENTIAL PROBLEMS AND SOLUTIONS

It is expected that the use of radioactive isotopes and quantities of radioactive wastes produced in the Basin will increase in the future. Controls for the use of isotopes and the disposal of wastes is a State responsibility. Funds and personnel should be made available that will permit the States to have a balanced and effective program.

Solutions to future problems would include the following:

1. Enactment of specific legislation by Georgia to control radioactive pollutants and license radioisotope users.

2. Provide sufficient funds and personnel for a state program of control, licensing, and minitoring of air, water, milk and foods.

SOLID WASTES

INTRODUCTION

Most communities collect and dispose of solid wastes as a governmental service, financing the operation by general taxation or by a special service charge. In a few instances, the collection and disposal is left to the individuals producing the waste or to private collectors who charge a fee for the service.

Methods of disposal vary, including dumping (and burning) on the surface, placing in sanitary landfills, and incineration. The amount of wastes produced on a national average is 0.8 to 1.0 cubic yard or about 650 pounds per person per year (approximately 2 pounds per person per day).

Incineration is considered one of the best methods of disposal but none of the communities in the Basin are using this method. Incineration of waste is not economical for most communities of the size found in the Basin since it usually requires a population of 50,000 or more to support this operation.

Sanitary landfills are the best method of waste disposal for any small community having suitable land available within reasonable hauling distance, which can be used at a cost which is not prohibitive. It is an effective and proven method, accepted by the State departments of public health.

PROBLEMS

Of 65 communities having populations of 500 or more in the Savannah Basin, 11 are reported having a satisfactory method of refuse disposal. Of the 11 communities with satisfactory disposal methods 7 are in South Carolina and 4 in Georgia.

Open dumps with burning are the usual method of disposal in the basin but it is not an acceptable method because of the health problems and nuisances created. Unburned garbage and refuse provide both food and harborage for insects and rodents and the odors and smoke produced are a nuisance over wide areas. Costs, ignoring benefits, for open dumps are approximately 50 percent of that for operation of sanitary landfills.

STATUS OF EXISTING PROGRAMS

State and local health departments have adequate authority to control the storage, collection and disposal of refuse. However, it is usually considered and handled as a local problem with consultation from State departments of public health.

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EXISTING NEEDS

There is a need in the Basin to provide approved waste disposal practices in an additional 54 communities which have a population sufficient to support a refuse collection and disposal program. In communities of under 500 population good housekeeping practices can be practiced by the individual. Most communities will need to adopt regulations to enable them to cope with the problem.

POTENTIAL PROBLEMS AND SOLUTIONS

Using a land requirement of one acre per 10,000 persons per year, the land acres shown in Table PH-6 will be necessary for refuse disposal for the period 1960-2000.

TABLE PH-6
LAND REQUIREMENTS FOR REFUSE DISPOSAL
YEARS 1960 - 2000
SAVANNAH BASIN

Period of Time	Number of Communities	Avg. Population to be served	Avg. Annual Costs	Acres Required
1960-1964	13	423,600	$ 531,900	217
1965-1974	65	611,000	1,008,000	611
1975-2000	67	966,000	1,391,000	3,480
			Total	4,308

COSTS AND BENEFITS

Present costs for construction of incinerators range from $2000 to $4000 per ton daily capacity. Operational costs vary considerably with the City of Atlanta reporting $1.48 per ton for the year 1959, and $1.27 per ton for 1960. Other cities report costs two to three times this amount.

Cost of operation of sanitary landfills averages $0.50 to $1.00 per ton of refuse handled. Cities as large as Los Angeles, California, and New York City use this method of disposal. New York City's experience has shown that disposal by sanitary landfills costs approximately half that of incinerators.

Sanitary landfills require about one acre of land for proper disposal of wastes from 10,000 people each year. Costs of operation of a solid refuse program including collection and disposal will vary with each community but will, depending on the size of the community, range from $1.00 to $4.50 per person per year. Based on a scaled cost, annual cost for a solid refuse disposal program in the Savannah Basin will be an average of $531,900 for period 1960-1964, $1,008,000 for 1965-1974 and $1,391,000 for 1975-2000.

SUMMARY AND CONCLUSIONS

SUMMARY

Insect-borne diseases do not constitute a major health problem in the Basin now, but the following diseases do present a continuous threat: encephalitis, malaria, typhus fever, Rocky Mountain spotted fever, and conjunctivitis. A proportion of enteric disease transmission in the Basin by houseflies.

The most serious public health insect problems in the Basin are the salt-marsh nuisance mosquitoes in the seashore counties, and secondarily the houseflies and eye gnats.

Important vector problems due to man's activities include those associated with the disposal of sewage, the storage and disposal of refuse, water-holding catch basins, uncontrolled flow from artesian wells, the disposal of dredge spoil material, and the accumulation and disposal of feed wastes and manure on farms.

There is no statewide enabling legislation for vector control districts in Georgia or South Carolina.

Present vector control programs consist of 12 countywide vector control programs in South Carolina, 1 mosquito control commission in Georgia, several municipal mosquito control programs in Georgia, malaria mosquito control programs at Clark Hill Reservoir and Hartwell Reservoir, and modest general vector control programs on military and U. S. Atomic Energy Commission installations.

Major air pollution sources are primarily located in the counties of Burke, Chatham, Elbert and Richmond in Georgia with minor problems occurring in the more heavily populated counties of South Carolina. The problems are dust, gases, smoke, fly ash, odors, and particulate matter.

Sources of radioactivity in the Basin are the Savannah River Plant of the Atomic Energy Commission and users of radioisotopes in the Anderson, Augusta, Clemson, and Savannah areas.

Solid wastes collection and disposal are being handled satisfactorily by only 11 of the 65 Basin communities having over 500 population. These 11 communities and/or counties are using sanitary landfills, two are using modified landfill operations and the other 52 communities are using some other unsatisfactory disposal method, mainly open dumps.

CONCLUSIONS

Surveillance and technical assistance needs to reduce public health problems associated with insect and rodent vectors are:

1. State enabling legislation permitting the establishment of tax-supported vector control districts in any county of Georgia and South Carolina.
2. Regulations requiring the control of wasteful flow from artesian wells.
3. More extensive surveys of vector disease occurrence and vector problems.
4. Increased training of local health department personnel in vector control intelligence.
5. Expansion of entomologic and engineering consultative services to agencies, industries, and individuals concerned with water and land resource developments.
6. Development of better permanent control techniques in salt marshes to serve multi-interests.
7. Development of better equipment and methods for constructing and maintaining water management ditches.
8. Establishment of a mosquito control district in Beaufort County, South Carolina.
9. Development of county-wide water management systems and programs.
10. Improved design for catch basins.
11. Increased use of sanitary landfills, and increased use of county-wide refuse collection systems.
12. Increased use of sewers and central treatment plants in lieu of septic tanks in new subdivisions.

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13. Development of improved methods for the sanitary handling of manure and other wastes on livestock and poultry farms.

14. Implementation of increased programs for the control and progressive eradication of alligatorweed, water hyacinths, and other obnoxious weeds in the Basin.

15. Better coordination between agencies so that vector control programs are compatible with multi-purpose functions.

16. Establishment of county-wide rodent control programs where none exist.

17. Development of effective techniques for the control of eye gnats.

18. Initiation of a state-aid financial program in Georgia.

19. Greater consideration of mosquito prevention and control measures in connection with future spoil dredging activities.

Based on present knowledge, a vector problem that appears to be on the rise and could be a significant one in the Basin in 1975 or 2000 is mosquito-borne encephalitis. At the present time, the only feasible control of encephalitis is a program of mosquito control for the community (or population groups) and protection against mosquito bites for the individual. Adequate housefly control is needed to eliminate the transmission of enteric diseases by the vector route.

Continued industrial expansion in the larger cities such as Savannah, Augusta, and Anderson will bring new and expanded air pollution problems. State programs should be expanded to cope with these problems. The needs and solutions for the State of Georgia have been more adequately determined by the air pollution survey which is to be released at an early date.

Radiological health programs should be expanded to collect background information on radioactivity, as well as to maintain surveillance and control of radioisotope users. The U. S. Atomic Energy Commission's plant operation in South Carolina should continue to be monitored by that agency and by the two States which have responsibility for radioactivity control programs.

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Solid wastes collection and proper disposal should be expanded to reach all communities of 500 or more population. The two existing modified landfill operations should convert immediately to a program of sanitary landfill operation and the remaining 52 communities should institute sanitary landfill operations by 1965. Two additional communities will have reached or exceeded 500 population by 2000 and these should start sanitary landfill operations.

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APPENDICES AND BIBLIOGRAPHY

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APPENDIX
DEFINITIONS AND ABBREVIATIONS

1. cfs - cubic feet per second.
2. Garbage - putrescible animal and vegetable wastes resulting from the handling, preparation and consumption of foods.
3. gpcd - gallons per capita per day.
4. gpd - gallons per day.
5. mg - million gallons.
6. mgd - million gallons per day.
7. PE - population equivalent.
8. ppm - parts per million by weight.
9. Pollution, water - the addition of sewage, industrial wastes, or other harmful or objectionable material to water.
10. Quality, water - is defined as the expression of water characteristics in terms of its physical, chemical, bacteriological, biological, and radioactive content.
11. Resources, water - is defined as the water available to serve mankind and his civilization for the varied, complex, and often conflicting beneficial uses. These uses include sources for municipal and domestic supplies, agriculture, industrial development, and for recreation, propagation of aquatic life and other forms of wildlife, navigation and ultimate waste disposal.
12. Supplies, domestic water - are those supplies used for individual families, including those also serving tenant families living on the property. Domestic supplies do not include commercial establishments, schools, churches, or camps.
13. Supplies, industrial water - are considered as industrially owned supplies, primarily developed for process or cooling purposes but which might be incidentally used for sanitary purposes.
14. Supplies, municipal water - are public supplies serving a municipality or communities of 50 or more people.
15. Supplies, semi-public water - are supplies for schools, motels, camps, and other supplies serving water to the public; or commercial establishments not classed as municipal or industrial.
16. Wastes, municipal - include all liquid wastes received by community sewers.
17. Wastes, industrial - the liquid wastes from industrial processes as distinct from domestic or sanitary sewage.
18. Wastes, solid (or Refuse) - includes all wastes of a solid nature not otherwise disposed of to the sewers or to the atmosphere. This includes all putrescible and nonputrescible solid wastes such as garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and solid market and industrial wastes.

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19. Wastes stabilization ponds - a properly engineered and operated pond for the biological reduction of organic wastes.
20. Water supply systems - includes the works and auxiliaries for collection, treatment and distribution of the water from the source of supply to the free-flowing outlet of the ultimate consumer.

Note: For the definition of any other terms which are used on these memoranda refer to Glossary of Water and Sewage Control Engineering, 1949 ASCE

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